WIRE AND WIRE PRODUCTS

JUNE 1935

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OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

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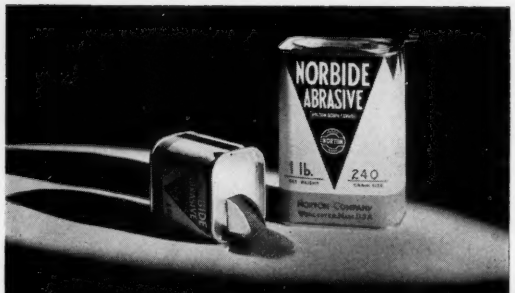

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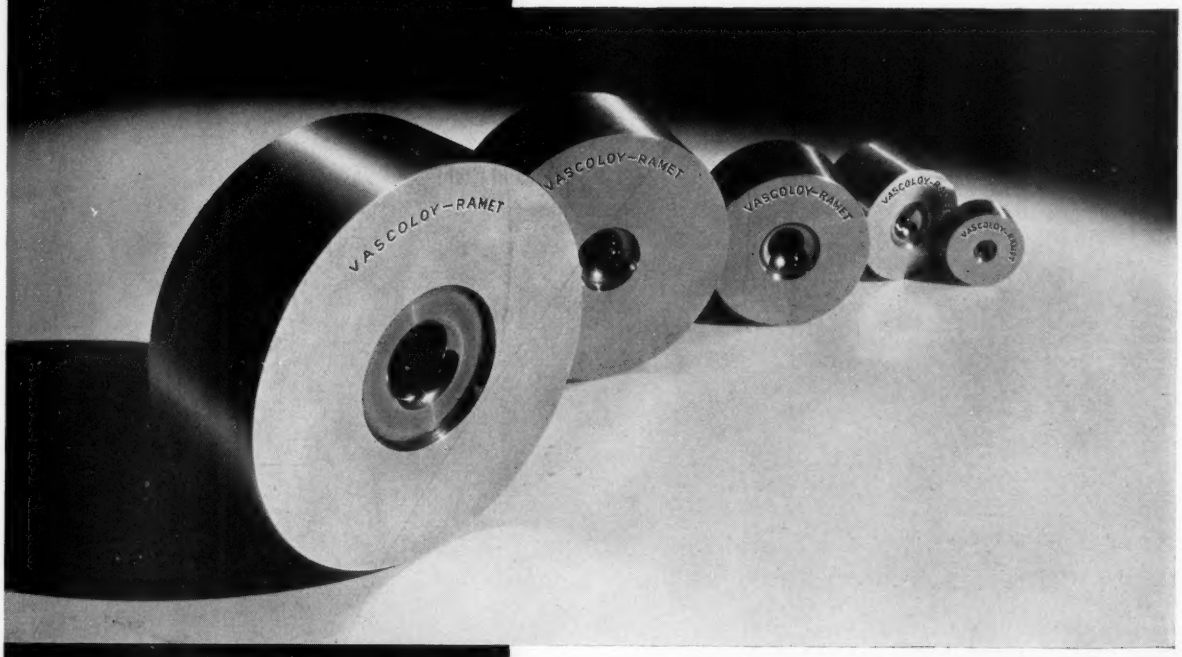

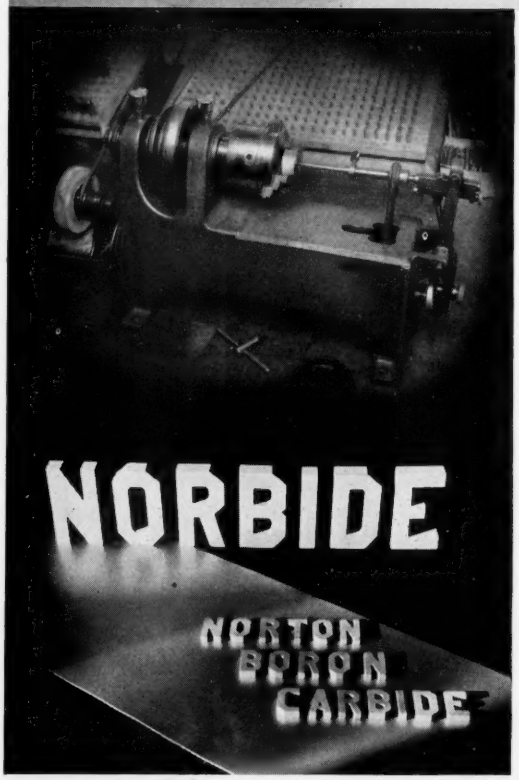

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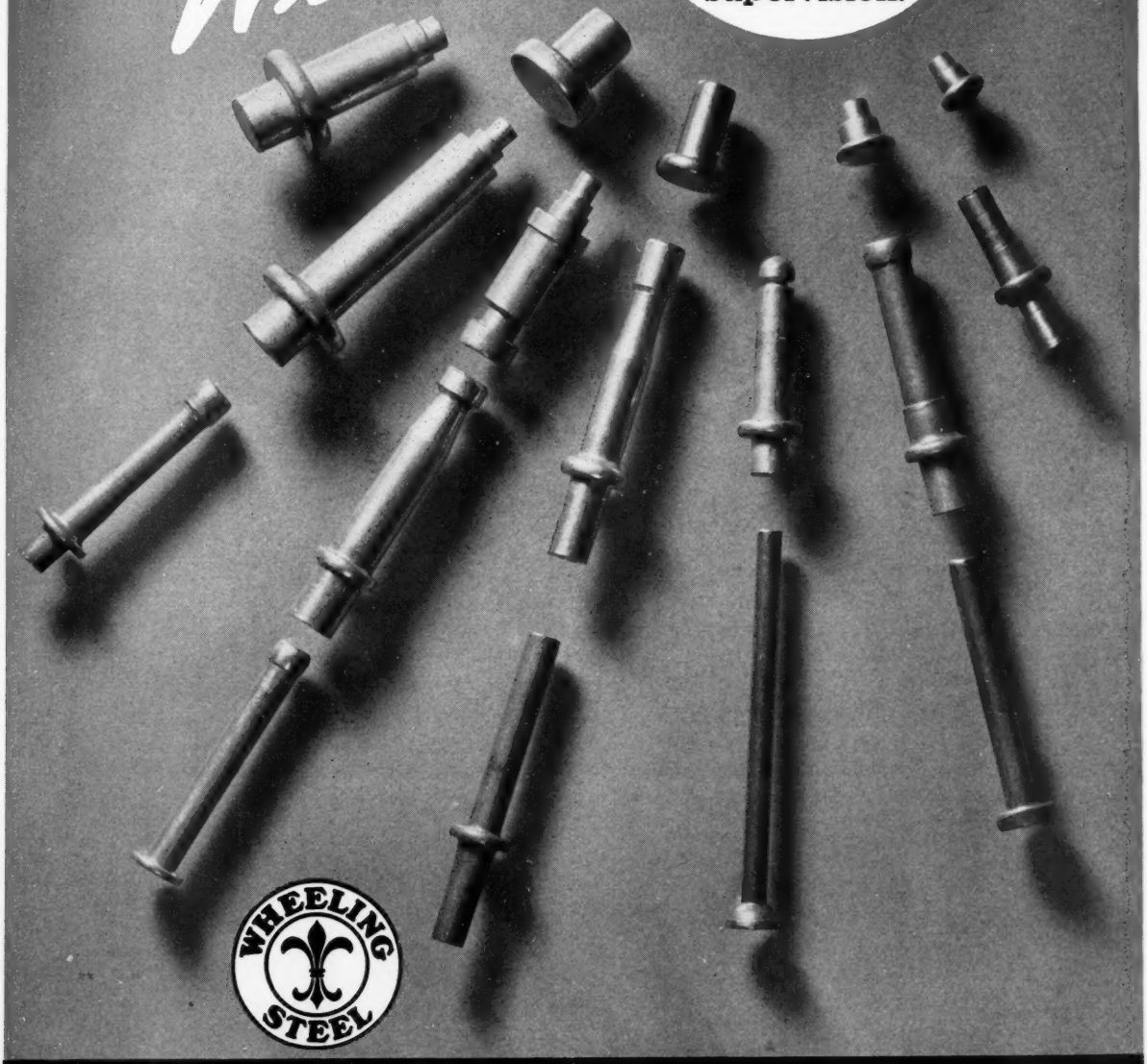

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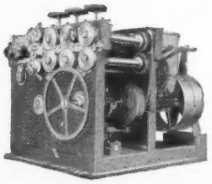

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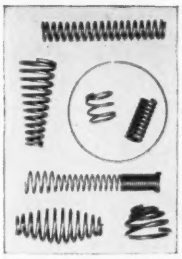

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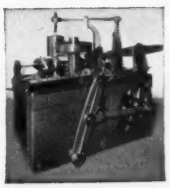

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At Chicago, Ill., September 30; Oct. 1, 2, 3, 4, 1935

In Association With the National Metal Congress

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✦ ✦ ✦

THE Wire Association serves as a technical society interested in the purely technical problems concerning the wire industry.

✦ ✦ ✦

The membership of the Wire Association includes:

1. Manufacturers of wire, rod, strip, cold drawn shapes and tubing.
2. Users of wire—Manufacturers of wire products.
3. Manufacturers of machinery and supplies pertinent to the wire industry.

✦ ✦ ✦

IN addition to the subjects covered by the technical papers at this meeting, one entire session will be devoted to open discussions of the joint problems of users of wire and the manufacturers of wire who supply them.

✦ ✦ ✦

IT is expected that an interesting meeting covering many practical problems common to the users of wire and to the companies drawing the wire will develop, and that information of benefit to both will result.

✦ ✦ ✦

Every wire mill production executive engaged in the manufacture or fabrication of wire and wire products of any kind is invited to join the Wire Association and attend these meetings.

✦ ✦ ✦

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17 East 42nd St. New York, N. Y.

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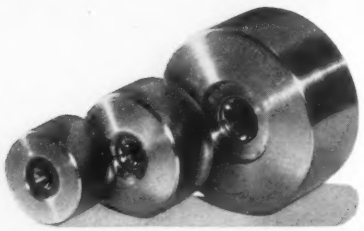

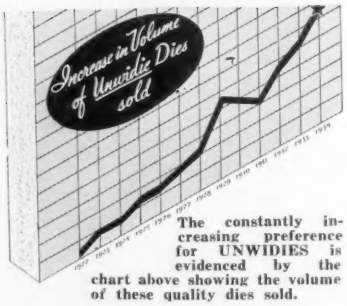

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WIRE AND WIRE PRODUCTS

Vol. 10 June 1935 No. 6

Designated as
Official Publication By The Wire Association

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Publication Office: Washington, N. J.
Annual Subscription, U. S. $5.00, Canada $5.60
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✦ ✦ ✦

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Exposition at the
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✦ ✦ ✦

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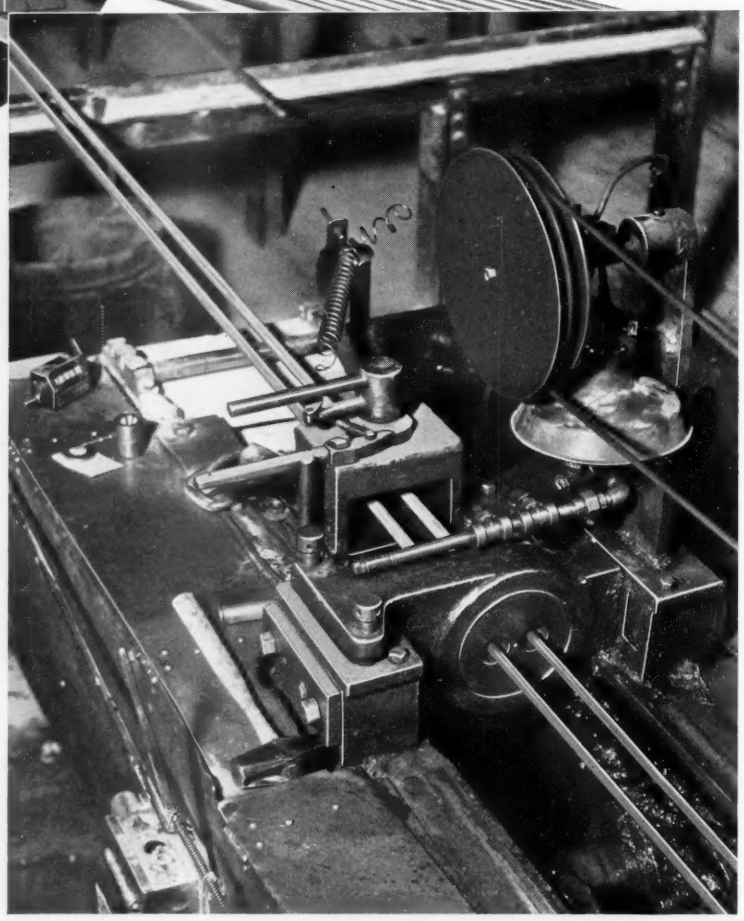

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 10 JUNE 1935 No. 6

Drawing Wire Shapes

By Richard Saxton

Sheffield, England

Shape drawing is not confined to one class of material or metal, and in carbon steels is produced in qualities ranging from mild to as high as 0.85 carbon content. The object of this article is to describe the drawing of shapes in various qualities of carbon steels, their purpose, and the reaction of the metal to the pressure imposed at various stages of the reduction. ✦ ✦ ✦ ✦

IN the mild or annealed condition practically all steels up to 0.9 carbon can be reduced two sizes in one draft where pressure is evenly distributed as in cylindrical reduction, and advantage is taken of this fact in shape drawing to distribute the pressure in order that greater essential reduction can be performed where necessary.

✦ ✦ ✦

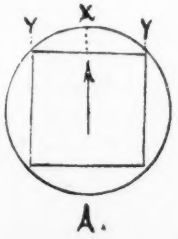
WHEN drawing square from round it is possible to reduce three-and-a-half to four sizes in the first draft, but to avoid fracture of the material a corresponding ease of pressure at other points must accompany the heavy reduction.

✦ ✦ ✦

DIAGRAM A, which shows cross-section of material in the cylindrical and square form illustrates how pressure is distributed. As will be observed, greater pressure, (3½ to 4 sizes) is at X, gradually decreasing to nil at Y - Y.

✦ ✦ ✦

HEAVY reduction in this manner is only essential during the first, or first and second drafts, later drafting being graded to distribute pressure over the whole periphery of the shape. Where design entails deep deformation as in the forming of a channel or groove, extra pressure at this point must be counterbalanced by easing at those points forming the broader parts of the design.



A.

THE most intricate and probably most difficult design to produce, is the lock coil shape as employed in the construction of the outer layers of locked coil winding ropes. As the name denotes these wires interlock when laid, binding the circumference of the rope and holding inner wires in position. A further feature is that should an outer wire fracture, it is held in position by the lock and prevented from fouling the rope.

✦ ✦ ✦

IN many cases where locking wires are found fractured in ropes when at work, the cause is usually assumed to be due to defective quality material. Whilst defective material can, and is produced during manufacture, it is practically impossible for defective raw material or wire rod to reach the finished wire stage, the severe stresses imposed during reduction exposing defects by fracturing at defective part when subjected to pressure of die.

✦ ✦ ✦

LOCK coil wires for winding ropes are constructed from best quality steel billets produced by the acid open-hearth process

Designated as Official Publication by the Wire Association

and, in accordance with specifications must be one of the following qualities:

Grade A. Special acid or "Swedish" quality.

Grade B. Acid quality.

✦ ✦ ✦

THE superiority of acid material to basic in winding ropes is greater resistance to frictional wear, and lesser liability to fatigue stress.

✦ ✦ ✦

WHERE defective wires are found after passing tests specified for finished material, these can safely be assumed to be due to faults in manufacture or overwork of rope, this latter leading to a brittle condition of the wires induced by the extra stresses imposed.

✦ ✦ ✦

FIG. 1 gives a rough idea of a cross section of the material in the rod and finished form, the circle indicating approximate size cylindrically proportionate to the finished shape. Finished material for winding rope construction is drawn to give a breaking strain of 85/90, 90/100, or 100/110 tons per sq. in. as required, and must withstand without fracture a torsion test of 22 twists in an 8 in. length.

✦ ✦ ✦

THE rods as received from the rolling mill are too hard for the severe reduction necessary in what is termed the roughing draft, and are first annealed. In order to simplify description of method the production of a locking wire known in the trade as Ai 10 is given, this being drawn from a 2 S.W.G. annealed acid quality rod with a carbon content of 0.75 per cent, and giving in the finished wire a breaking strain of 95/100 tons per sq. in.

AFTER annealing and cleaning the material is reduced in one draft to shape as Fig. 2. Due to amount of superfluous metal removed in this draft material is too hard to submit to further reduction, and is again annealed. Following second annealing material is reduced two drafts and assumes shape as in Fig. 3.

✦ ✦ ✦

IN this shape and size it is ready for the patenting or tubing operation, a continuous normalising treatment which eliminates stresses set up by previous work and imparts the tenacity and ductility essential to produce, in conjunction with subsequent drawing operation, breaking stress and flexibility specified. Without this patenting treatment it would not be possible to produce the high strains and flexibility demanded in modern winding ropes.

✦ ✦ ✦

RETURNED to the drawing mill after patenting and cleaning, material is subjected to third and final drawing operation. This consists of 4 drafts, each graded to permit of a reduction of 1¼ sizes at even circumferential pressure in the finishing draft. Fig. 4 illustrates shape of finished wire.

✦ ✦ ✦

WHILE the process of drawing this type of locking wire may appear fairly simple, a high degree of skill is necessary in the construction of tools and dies, failure to form the flat side A—A at correct angle resulting in gaps being formed between wires when laid in lock. Though no detriment to efficiency of rope these gaps permit damp and grit to penetrate to inner wires, setting up internal corrosion.

Fig 1.

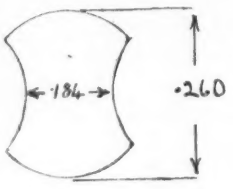


Fig 2

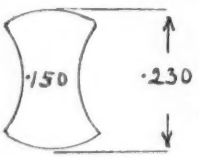


Fig 3.

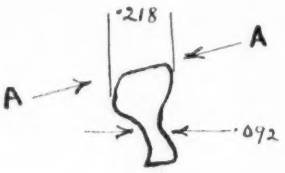


Fig 4.

CORRECT preparation of the dies plays an important part in efficient production, projecting pieces, which perform the deep deformation necessary to form the grooves, being easily chipped or broken if tool is not inserted correctly. All dies for locking wires must be opened to size while in heated condition after "battering", a process of closing and forming bearing. Tool employed to set die must be used to open bearing while in heated condition as, when cold, this will not form to shape required.

SHOULD the setting tool be broken during operations and a fresh tool be necessary, dies must be heated and closed, then re-opened with the new tool in order to conform to shape. The intricate design makes it almost impossible to produce two tools exactly alike at all points, and failure to adjust the bearing to the tool while heated results in a fracture of the latter when setting die in the cold state. Due to this slight variance in the making of the tools it is the practice for all finishing tools to be made by one operator.

✦ ✦ ✦

IN comparison with round wire (strand) ropes advantages gained by including this type of shape in the construction are: more material in equal area, and 17 per cent less diameter for equal tensile or 45 per cent greater strength for equal diameter. The surface presented to frictional wear is greater while the elongation under load rarely exceeds 3 per cent.

✦ ✦ ✦

LOCKING wires are not confined to use in winding ropes only, larger and different shapes being employed in the construction of guide ropes. Ductility, breaking

stress and torsional qualities not being as important as in winding rope construction, the drawing practice is more simple, the majority being shaped in the hot rolling operation.

✦ ✦ ✦

WIRES for locking guides, as they are termed, are drawn to give a breaking strain of 45 to 50 tons per sq. in. This class of shape, for which a carbon content of 0.35 to 0.40 per cent is employed to furnish the 45/50 tons stress required, is usually drawn from the shaped rod in two drafts with one intermediate annealing. Patenting heat treatment is only employed where required in high tensiles.

Fig 5.

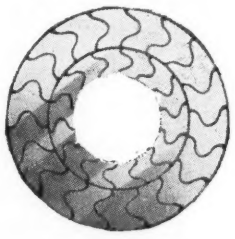


Fig 6.

Fig. 7.

✦ ✦ ✦

FIG. 5. illustrates an improved form known as the tubular guide, for which is claimed 50 per cent wear before risk of wires disengaging. These ropes being hollow are lighter, and on test furnish complete resistance to deformation under lateral pressure. The design of the wires, it will be observed, is totally dissimilar to that of wires incorporated in lock coil winding ropes.

✦ ✦ ✦

FIG. 6. illustrates as employed in aerial ropes.

✦ ✦ ✦

A SIMPLE shape to produce a that known as flat oval which is produced from suitable strip. With small quantities it is the practice to cold roll a cylindrical wire to a suitable size in flat to finish to oval in two drafts. Fig. 7 shows at A. cylindrical wire flattened to size, and at B. the finished oval.

✦ ✦ ✦

OVAL wire, known as two-size flat, is finished from cylindrical material without intermediate annealing. As the term indicates, the material is two sizes larger on broad side. Oval 10 by 12 S.W.G., or 9¼ by 12, can be drawn from 5 G. patented rods to give a breaking stress of 85/90 tons per sq. in. without intermediate annealing, the material being reduced in cylindrical form to 9½ S.W.G., then shaped in the last or finishing draft. For 9¼ by 12 S.W.G. the material is drawn to 9 S.W.G. cylindrical.

✦ ✦ ✦

HALF-ROUND shapes present the most simple proposition in shape drawing as, in thicker sizes, it is possible to shape to suitable size in rod to finish in one reducing draft. In adopting this method, size in rod must be graded to impose equal pressure on edges as imposed elsewhere, any easing at these particular points leading to a wearing or cutting effect by material, with consequent spoilation of die.

✦ ✦ ✦

SQUARE wire. Square shapes are rarely roughed from square material, drawing from cylindrical form in the rod proving a more economic proposition. To form a correct square from round necessitates a reduction of from 5 to 7 sizes, exact number being dependent on size of finished wire. It is the practice when drawing square or flat shapes to bevel the sides in intermediate drafts, thus throwing greater pressure on corners and preventing rapid wear of die by edges of square.

✦ ✦ ✦

A BETTER shape, formed in the draft preceding reduction to finished size, is to slightly hollow flats. The finishing die when reducing this shape stands up to pressure much better, giving higher output per setting.

✦ ✦ ✦

WHEN drawing shape wire, particularly in the roughing draft, it is essential that a wide, short bearing be employed, or fracture of the material and defective bearing results. The angle as employed in the reduction of round material is too narrow to permit of easy slip if used in shape drawing, and easy slip is essential for conversion into shape or irregular design.

✦ ✦ ✦

BEFORE commencing drawing high carbon material to a specified tensile shape it is advisable to submit to analysis for carbon content, for where requiring 4 to 6 drafts to finish after patenting, a decrease of two points or over in carbon means a decrease in tensile stress in the finished wire of approximately 3 tons. Material found too low in carbon after being drawn cannot be reshaped to cylindrical form again, and unless able to be utilized for a lower stress must be consigned to the scrap heap.

✦ ✦ ✦

WHILE many other shapes are produced, those enumerated here give a fair idea of the skill necessary to produce shape wire. Production, compared with cylindrical, is much lower, as a majority of shapes can only be drawn on single-drafting machines.

For
Exhibit Space
in the
Wire Association
Section
of the
National Metal Congress
Exposition
at Chicago, Ill.
Sept. 30 -- Oct. 1, 2, 3, 4
Address
Richard E. Brown, Secretary
The Wire Association
17 East 42nd St., New York, N. Y.

A Correlation of the Tensile Strength and Electrical Conductivity of Hard-Drawn Copper Wire With Preferred Orientation

PART III

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Abstract

Wire drawing is reviewed from antiquity to the present, with particular emphasis on present day drawing of copper wire. Unit cell orientation is deduced from micrographs and various types of X-ray spectra. These orientations are correlated with electrical conductivity and tensile strength, and explanations for the variations due to cold drawing are formulated. Similar correlation is done for copper wire, cold-drawn in various manners. Tensile strength does not vary appreciably but the electrical conductivity seems to be higher for wire drawn continuously than for wire whose direction of drawing is reversed. Published in three parts. ✦

Resistance to Deformation Correlated with Cell Orientation and Other Concepts

NADAI [10], in his treatment of plasticity, states that one property of the flow or slip of layers has an especial bearing on the mechanics of the plastic state. The planes of the thin slip layers in which the metal is apparently more severely deformed than elsewhere coincide approximately with the two planes of principal shearing stress. In the case of tension the angle which the slip layers make with the axis of the test piece is usually about 47°, a little greater than the angle in a compression test piece—45°. In copper crystals, the octahedron planes act as slip planes, and the edges of the octahedron represent the direction of the slip. The 100 planes are the planes of second easiest slip. [11]

✦ ✦ ✦

THE X-ray spectra obtained indicated that two orientations were present in the core: one with the cube diagonal, 111, in the core of the wire, and the other with the cube edge, 100, in the core. The prevalence and the relative intensities of the spots in the spectral pattern indicated that the 111 orientation occurred about twice as frequently as the 100.

✦ ✦ ✦

IN a cube the 111 faces form an octahedron. When the cubes (unit cells) are so oriented that the 111 direction is in the core of the wire, one set of 111 planes is perpendicular to the deforming force and the other three sets make 18°-25′ with the tension. The 100 planes make an angle of 35°-14′ with the drawing force.

✦ ✦ ✦

THE 111 planes in the face-centered cubic cell are those of easiest slip: the atoms on these planes are closer together than on any other, and for face-centered cubic symmetry the planes themselves are planes of greatest interplaner distance. When copper is cold-drawn into wire the planes of easiest slip and of second easiest slip are so oriented that they make angles with the deforming force which are very unfavorable to slipping. Such reduction of slip possibility means an increase in the tensile strength, a conclusion which is in exact accord with the orientation tensile strength findings of Harris. [12] A consideration of the preferred orientations in cold-drawn wires of aluminum and silver, and of the relative tensile strength increase of cold-drawn wire over that of the cast or annealed metal, also corroborates this conclusion.

✦ ✦ ✦

SCHMIDT and Wasserman [13] state that aluminum when cold-drawn is oriented with only the 111 direction in the wire axis, a fact which would indicate a large relative increase in tensile strength. On the other hand the unit cells of cold-drawn silver wire are oriented, as is copper, with both the 111 and the 100 directions in the wire axis, but the 100 are three times as numerous as the 111. Cold-drawn copper is between the two, with 60 per cent of the 111 and 40 per cent of the 100. The 100 orientation is one which is very advantageous for drawing inasmuch as it so places the 111 planes that they make a 45° angle with the pulling force—the condition for maximum ease of slip. Hence it might be concluded that the relative change in tensile strength in wires would vary directly with the per cent 111 orien-

✦ ✦ ✦

TABLE III

Tensile Strength

Metal	111	100	Annealed	H. D.	% increase
Silver	25%	75%	21,000	40,000	100
Copper	50%	50%	31,000	72,000	140
Aluminum	100%	0%	10,000	30,000	200

tation and inversely with the 100 orientation. This is shown to be true in the case of copper, silver, and aluminum. From the annealed to the cold-drawn state, aluminum increases in strength about 3 times, copper about 2.4 times, and silver about 2 times. (Table III). This is for the total wire, about half of whose diameter is core, preferredly oriented, the other half being randomly oriented.

✦ ✦ ✦

ANOTHER possible factor which may enter into the problem is disorganized material on the slip-planes which is due to slip. Whether this be truly amorphous or exceedingly finely crystalline material (crystal fragments) the facts are that below the equicohesive temperature this disorganized material is harder than the truly crystalline and that fractures are usually intra-crystalline rather than inter-crystalline. To be harder means that the atomic attraction forces are greater than the repulsion forces. If one accepts Coulomb's inverse square law of attraction, and also the hypothesis that the repulsion varies inversely as some higher power of the internuclear distance, the foregoing findings as to hardness mean that the nuclei are closer together.

✦ ✦ ✦

DENSITY measurements, obtained by the Pyknometer Bottle Method and corrected for atmospheric conditions, indicate that in both hard-drawn Lake copper and hard-drawn electrolytic copper the density of the core is greater than that of the outer mantle. Both these densities are less than the density of the annealed wire. (Table IV). Apparently the mechanism of slip on slip-planes is different from that which orients the cells in the grains in the core. One possible explanation is that in some manner the lattice discontinuities which are caused by slip are filled with a denser, disarranged, amorphous, or fragmental material. The equicohesive temperature might be considered to be the one at which the atoms attain enough mobility to regain their equilibrium between the forces of nuclear attraction and repulsion.

THE microscopic examinations of cross section, both vertical and longitudinal, of the hard-drawn copper wire, show practically no variation in grain size from surface to core, but Rockwell tests show quite a large variation in hardness (Table V). The hardnesses were taken of both cross and longitudinal sections. For the longitudinal section the wire was bent along a long radius curve, and the outside of the curved section was then polished off until the center of the core was exposed. Since hardnesses were taken along the polished section, a thorough survey of the material from core to surface was possible. Hardnesses were also taken across the shorter dimension of the polished surface, on end sections of pieces of wire, and along the middle of the core of pieces of sections which had not been bent. The results all showed that the core zone of the wire was the hardest portion.

✦ ✦ ✦

TABLE IV

Density of Copper Wire

Average Density of Hard Drawn Wire	
8.8430	
8.8435	
8.8433	
8.8433	Average
Density of Core of Hard Drawn Wire	
8.8588	
8.8563	
8.8510	
8.8492	
8.8512	
8.8518	
8.8525	Average
Density of Whole Wire Annealed at Cherry Red Heat in Assay Muffle	
8.8559	
8.8683	
8.8640	
8.8604	
8.8621	Average
Density of Whole Copper Wire Annealed at From 1050°C to Near the Melting Point. The Wire Softened in Some Places.	
8.8656	
8.8609	
8.8691	
8.8688	
8.8653	
8.8607	
8.8689	
8.8686	
8.8659	Average
The Above Measurements Are All From Sections of the Same Wire.	

BECAUSE grain size did not vary from the surface to the core and because the hardness did vary and was greater in the core zone, hardness and tensile strength must be due to other factors than small-grain slip-interference. This conclusion is particularly well illustrated by the hardnesses along the long direction of the polished surface. Inasmuch as the core orientation is one which permits the unit cell to assume any position in 360° of azimuthal rotation around the 111 and the 100 axes, there is a greater possibility for the 111 and the 100 planes to make a 45° angle with the deforming force in the core than in the rest of the wire. A proof of this condition is that the longitudinal hardness of the core was greater than the core hardness at 90° to the core axis. This would seem to show that even though grain refinement and preferred orientation are eliminated from the equation, there is still something which causes an increased hardness—quite possibly a state of unstable equilibrium in which the forces of attraction are greater than normal. This condition in turn might well be due to the presence of a crystallographically disorganized material—amorphous or crystal fragmental.

✦ ✦ ✦

RECENT work with electron diffraction from polished metallic surfaces[14] shows that the surface material is in a "semi-orderly" condition. The diffraction pattern is very similar to that of liquids. French[14] found that the broad diffraction rings in the electron spectra of a polished copper surface were indicative of atomic spacings which differed from the atomic spacings in the crystalline state.

✦ ✦ ✦

IT is agreed that grain refinement causes slip interference, but grain refinement brings another possibility into the problem. Maximum ease of slip should exist when the planes of easiest slip make a 45° angle with the deforming force. It is easily seen that if a specimen containing 100

grains randomly oriented is broken up into 1000 grains, again randomly oriented, the probability is 10 times greater that there will be grains in optimum position for easy slip than in the original sample; therefore deformation should be easier and should tend to overcome the keying effect of smaller grains. This is a supposititious case in which no preferred orientation results from the grain refinement.

✦ ✦ ✦

IF, however, preferred orientation does result, as happens in the case of cold-drawn copper wire, and if it is one which opposes easy slip, its action and that of keying are additive.

✦ ✦ ✦

Conclusions

THE foregoing experiments show that copper, though an isometric metal, is not isotropic. The increase in hardness and the increase in tensile strength of cold-drawn copper wire are shown to be not only effects of small-grain slip-interference but also functions of unit-cell orientation and to be due to the probable presence of another phase of an amorphous (crystal fragmental) condition.

✦ ✦ ✦

Electrical Conductivity and Cell Orientation

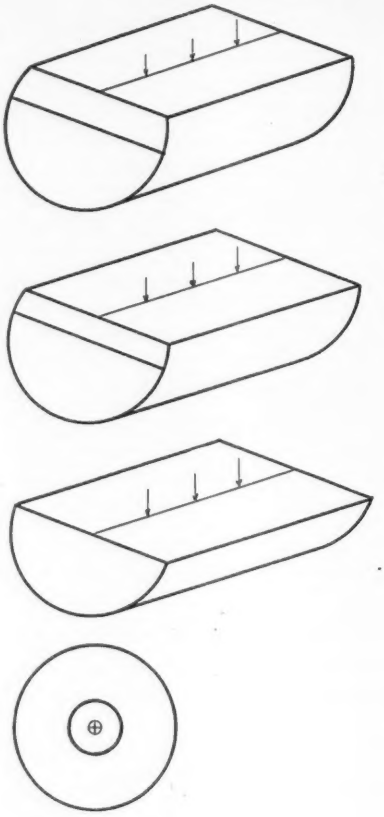
THE X-ray spectra showed a thin skin of preferredly oriented material on the outside of the wire, then a layer of randomly oriented grain, and then the core of preferredly oriented material. The diameter of the core was about one-half the total diameter of the wire. The orientation of the unit cells in the core and in the skin was the same. The specific resistivity of the skin was found to be greater than that of the randomly oriented material just beneath, and this specific resistivity increased as more and more of the wire was etched off and as, ipso facto, the core was approached.

✦ ✦ ✦

AN analytical consideration of the planar orientation in the core of the cold-drawn wire shows that one set of 111 planes is perpendicular to the longitudinal axis and that at least 60 percent of the orientation is one with 111 planes in the cross-section of the wire, the other 40 per cent being one with 100 planes at right angles to the core.

TABLE V

HARDNESS OF HARD-DRAWN COPPER WIRE



51.5			
52.0			
51.0			
51.0			
54.0			
51.5			
			51.8 Av.
47.5			
56.5			
53.0			
53.0			
49.5			
			51.9 Av.
52.5	57		
53.0	53		
57.5	55		
50.0	54.5		
51.0	54		
56.0	54.5		.....
53.5	53		
			53.9 Av.
59.5	56	51	
50.0	51	57	
57.5	57	60	
50.0	56	57	
59.0	51	57	
52.0	61	52	
			56.3 Av.

✦ ✦ ✦

ISOTROPIC crystals have like properties in all directions. Dana[16] emphasizes the fact that such crystals are not isotropic with reference to those properties which depend upon molecular structure alone, such as cohesion and elasticity; to these can be added thermal conductivity and (by analogy) electrical conductivity. Davey[15] found variations in electrical conductivity along different directions in a copper crystal.

✦ ✦ ✦

HUDSON[17] states that the outermost, or valency, electrons in atoms are the electrical conductors. The orbits of these outermost electrons may actually intersect, and in certain positions the nuclear attraction for an electron may be neutralized by the attraction of the nuclei of other atoms, the change from neutral to charged state occurring as often as 40,000,000 times per second. The space between the atoms is thus filled with detached, or free, electrons forming an electronic gas. These free electrons move about in a manner similar to molecules. Their motion will be interrupted or affected by collision or by nuclear attractions. There will be no tendency for them to move very far from their origin, because each electron is continually pulled back into its original orbit or that of an adjacent atom, a phenomenon which will be discussed later in correlating the conductivity with the space lattice. Hudson further states that the conductivity of a solid depends upon the space density and the freedom of the electrons in the electronic gas which fill the space between the orderly rows of atoms. If an electric potential is maintained between any

TABLE VI

Plane	Relative Nearest Distance of Approach of Atoms	Relative Interplanar Distance	Relative Atomic Dist. From Plane to Plane	Rel. Average Interatomic Dist. in Plane
111	0.707	0.577	0.707	0.707
(100) (2)	0.707	0.500	0.707	0.854
(110) (2)	0.707	0.353	0.707	1.038

two planes in any solid, the free electrons not only have a random and rapid thermal velocity but also are given a small drift velocity in a common direction. This drift velocity constitutes an electric current.

✦ ✦ ✦

THUS the conductivity depends upon the space destiny of the free electrons and upon the mean free path for each electron. This path is affected not only by collisions but also by the nuclear attractions of the vibrating atoms in the solid.

✦ ✦ ✦

THE octahedral planes have the greatest number of atoms per unit area, and consequently, exert a greater amount of attraction for the free electrons per unit area than does any other plane in face-centered cubic symmetry. The octahedral planes have also the greatest interplanar distance — a greater distance to "drift" the free electrons than that of any of the crystallographic planes.

✦ ✦ ✦

IN other words, if the attraction per unit area of atomic plane varies as the density of atomic population, the 111 plane will have a greater attraction for the free electrons of the electronic gas than will the 100 planes, which have a lower atomic density and will therefore have less attraction for the free electrons.

✦ ✦ ✦

THE average relative interatomic distance in the 111 planes is 0.707. (The edge of the unit cell is taken as unity). The average relative interatomic distance in the 100 planes is 0.854, and that of the 110 planes is 1.038.

✦ ✦ ✦

IT is not known whether Coulomb's inverse square law of attraction is valid at such small distances, but until proved invalid, it will be accepted as true.[35]

FROM this law it is possible to conclude that both the interatomic distance and the interplanar distance effect the drift of free electrons. In the first place, it is reasonable to suppose that the planar attraction for the electrons varies inversely as the square of the average interatomic distance in the plane. Hence the relative planar attraction of the 111, 100, and the 110 planes would be as:

$$\frac{1}{(0.707)^2} : \frac{1}{(0.854)^2} : \frac{1}{(1.038)^2}$$

or as 2 : 1.37 : 0.93. In the second place, if these three series of planes had equal interplanar distances, it would be more than twice as difficult to cause a free electron to "drift" from one 111 to the next 111 plane as to cause it to "drift" between two adjacent 110 planes. But these three series of planes do not have equal interplanar distances; instead, the relative interplanar distances are as 0.577 (111) : 0.500 (100) : 0.353 (110). This ratio would also affect the interplanar flow of free electrons. Again the inverse square law very probably would hold. If the planar attractions for the free electrons were the same for the 100, 110, and the 111 planes, the probabilities of the electron flow between the various planes would be inversely as the square of their interplanar distances.

111		100		110
$\frac{1}{(0.577)^2}$	:	$\frac{1}{(0.5)^2}$	:	$\frac{1}{(0.353)^2}$
: : 3	:	4	:	8

✦ ✦ ✦

THEREFORE if these relative planar attractions are taken into consideration the relative probabilities of the free electrons "drifting" between the 111 planes, between the 100 planes, and between the 110 planes can be computed as being:

111	100	110
3	4	8
2	1.37	0.93

or

1 : 2 : 6

✦ ✦ ✦

TO conduct electricity along a wire the free electrons must pass through the 111 planes, one set of which is perpendicular to the wire axis; this set is the most densely populated of the atomic planes. It is easily seen that an electron is less likely to pass through such a plane than through a more sparsely populated one.

✦ ✦ ✦

THE orientation in the core is a directional one; this of course means also a planar orientation—that is, one set of the 111 planes is perpendicular to the wire axis; but though there is a planar orientation there is nothing which indicates that the planes are so aligned as to result in perfect articulation. In fact, the arrangement is more likely to be a staggered one, which could further interfere with the passage of free electrons.

✦ ✦ ✦

THE probability that the deformation mechanism caused unit cells or small blocks of unit cells to preferredly orient themselves within the grains makes it likely that the core has much more intercellular or intercrystalline material than has the outer mantle. Hume-Rothery[19] says that "any conductivity measurements on polycrystalline metal involve the resistance of the intercrystalline material as well as that of the crystals themselves."

✦ ✦ ✦

Conclusions

ELECTRICAL conductivity is thus shown to be a function of cell orientation, and the cell orientation in the core of hard-drawn copper wire is shown to be one whose effects are adverse to the most efficient electrical conductivity.

Electrical Conductivity of Copper Wire Drawn in Various Ways

MODERN metallurgical research has made exceedingly great progress in the study and utilization of the possibility of improving the various properties of metals and alloys. Strength, reduction of weight per unit of strength, hardness, and resistance to fatigue, corrosion, and heat have all been the subject of much thought and experiment, with beneficial results.

✦ ✦ ✦

ALTHOUGH electrical conductivity has not been greatly improved, the conductivity of copper has in certain instances been increased somewhat by a more efficient removal of impurities, both in the smelting[20] and electrolytic processes.

✦ ✦ ✦

IT has been shown that the cold-drawing of copper wire continuously in one direction results in a certain fiber type of preferred orientation of the unit cells and that this type of orientation reduces the conductivity from that of an annealed wire, whose unit cells are more randomly oriented. It has been shown also that the conductivity of cold-drawn copper wire decreases toward the core of the wire and that the degree of such preferred orientation increases as the core is approached.

✦ ✦ ✦

RESEARCH was undertaken in order to determine which methods of wire drawing would result in different types of preferred orientation and possibly in an improvement in conductivity. Though copper is isometric it was hoped that some such condition might exist as does in calcite and quartz, in which the electrical conductivity in the direction of the main axis is exceedingly greater than in a direction perpendicular to it.[21]

✦ ✦ ✦

A SECTION about 8 in. long was cut from a commercial wire bar. This was machined to a square cross-section to eliminate any effects which might be due to surface conditions resulting from casting. The block was then cut into sections approximately ¾ by ¾ by 8 in., twenty such pieces being obtained from the block (Fig. 9). Each section was rolled to a size proper for drawing, and the entire section was drawn through one die and then cut into four pieces. These four pieces were then so drawn that from each section were obtained four wires, cold-drawn through 8 passes (8 dies) to No. 8 B. & S., with the following difference in drawing direction:

1. Continuous drawing through 8 dies.
2. Reversal of direction after each pass.
3. Reversal of direction after every other pass.
4. Reversal of direction after every fourth pass.

1	2	5	6	9	10	13	14
3	4	7	8	11	12	15	16
29	30	25	26	21	22	17	18
31	32	27	28	23	24	19	20
33	34	37	38	41	42	45	46
35	36	39	40	43	44	47	48
61	62	57	58	53	54	49	50
63	64	59	60	55	56	51	52
65	66	69	70	73	74	77	78
67	68	71	72	75	76	79	80

Fig. 9. Section of Wire Bar Showing Numbers of the Wires and Section of the Bar from Which the Wires Were Drawn.

✦ ✦ ✦

As a result of this technique, wires representative of the different methods of drawing were also representative of the entire cross-section of the wire bar. A slab ¾ in. thick was taken from the same wire bar; after the casting surfaces were planed off, it was cut into sections which were parallel to the top of the bar. These sections were then drawn in a manner similar to that explained above, merely to determine whether any anisotropy existed between the longitudinal direction and a direction at right angles to the long axis of the bar. No anisotropic condition was found which varied the final conductivity. The wire bar from which the section was taken had the following analysis:

Copper plus silver—99.930%
Silver—32.2 oz. per ton

✦ ✦ ✦

X-RAY spectroscopic examinations were made of wires representative of each type of drawing. Different parts of the wires were examined by successively etching off layers, each etching followed by a raying. In this manner it was possible to determine the type and degree of preferred orientation existing in any portion of the wire from the surface to the core. (Greenwood[22] in differentiating the degree of orientation with depth, used not only successive etchings but also radiations of different penetrations.) Successive Hull-Debye-Shearer spectra were obtained until the wires were approximately 0.2 mm. in diameter. Pinhole spectra were next obtained, first with the wire stationary and then with it rotating. Molybdenum radiation (30 KV) was used; the Hull spectra were obtained on a General Electric Diffraction Unit, and pinhole spectra were obtained on Pye and Hilger-Muller spectrographs.

✦ ✦ ✦

SPECTRA of the surface of the wires showed a thin skin of preferredly oriented material inside of which was material with a random orientation that developed

more and more into a fiber type of orientation as the core was approached. The spectra were symmetrical, both horizontally and vertically; the obvious inference is that the preferred direction, which would naturally be in the direction of drawing, was perpendicular to the X-ray beam. Evidence of the absence of perfect orientation was given by the almond-like shape of the spots, which formed almost complete circles.

✦ ✦ ✦

THE spectra of the wires revealed no difference in the cell orientation which could be considered as due to difference in methods of drawing. The preferred orientation was of two types, one in which the cube diagonal, 111, was in the axis of the wire and the other in which the cube edge, 100, was in the axis. Because of predominance of the spots which coincided with the theoretical locations of reflections due to an orientation with the 111 direction in the fiber axis, it was estimated that in the wires examined the 111 orientation was twice as prevalent as the 100. Because of the mechanism of deformation, perfect parallelism of the preferred direction is the hypothetical ideal. The deforming force really orients the preferred direction conically, the sides of the cone very closely approaching the axis, which is the axis of the wire. Apparently, the process involved in this type of plastic deformation is irreversible; that is, work applied in the opposite direction is unable to restore the initial state.

✦ ✦ ✦

UPON consideration of the conditions involved, the similarity of the spectra of the wires drawn in different manners is easily understood. Copper is isometric, and both the 111 and the 100 directions are axes of symmetry. The only effect of reversing the drawing direction on either of the two orientations would be merely to reduce the conicalness of the orientation or to effect a double-pointed-cone type of cell arrangement. Hence it might be concluded that, because of the great similarity of orientation, the conductivities would be approximately the same. This was found to be the case.

✦ ✦ ✦

THE conductivities varied within each type of drawing as well as between types (Table VII). The average conductivities indicated that the more frequent the reversal of drawing direction the lower the conductivity. The eight passes, all in one direction, lowered the conductivity to 96.45%; four reversals in the eight passes lowered it to 96.25%; and reversing after every other pass and after every fourth pass lowered it to 96.27% and 96.29% respectively. There was no appreciable variation in the tensile strengths of the different wires.

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AFTER being tested for conductivity the wires were annealed, and the conductivities were redetermined. The different meth-

(*Please turn to page 248*)

TABLE VII

Wire No.	Conductivity Wire continuously drawn through eight passes	Wire No.	Conductivity Direction of drawing reversed after each pass	Wire No.	Conductivity Direction of drawing reversed after every other pass	Wire No.	Conductivity Direction of drawing reversed after each four passes
1	96.30	2	96.15	3	96.15	4	96.15
5	97.25	6	96.40	7	96.40	8	96.15
9	96.25	10	96.00	11	96.40	12	96.35
13	96.05	14	96.35	15	96.20	16	96.05
17	96.50	18	96.25	19	96.20	20	96.40
21	96.30	22	96.30	23	96.20	24	96.45
25	96.30	26	96.25	27	96.30	28	96.30
29	96.40	30	96.00	31	96.25	32	96.30
33	96.60	34	96.15	35	96.10	36	96.20
37	96.40	38	95.95	39	96.30	40	96.35
41	96.50	42	96.05	43	96.20	44	96.20
45	96.45	46	96.15	47	96.30	48	96.40
49	96.60	50	96.50	51	96.20	52	96.35
53	96.20	54	96.40	55	96.40	56	96.20
57	96.50	58	96.05	59	96.10	60	96.35
61	96.40	62	96.25	63	96.35	64	96.25
65	96.30	66	96.05	67	95.90	68	96.30
69	96.20	70	96.65	71	96.35	72	96.45
73	96.65	74	96.30	75	96.50	76	96.45
77	96.85	78	96.70	79	96.60	80	96.20
	Average 96.45		Average 96.25		Average 96.27		Average 96.29

Inhibitors

By Kenneth B. Lewis
Consulting Wire Mill Engineer, Worcester, Mass.

The causes for the growing use of inhibitors outlined, together with an analysis of the results obtained therefrom. ✦ ✦

WHEN my friend **"Red" Lease,** skipper of the pickling cranes at Sparrows Point, burst into print with articles on pickling and inhibiting in the January and February numbers of Wire and Wire Products, a number of precedents went "boom" and the end of an epoch was sharply signalized. A wire man need not have any gray hairs to be old enough to remember when every normal cleaning circle was presided over by "old Mike" whose last name, if any, was known only to the timekeeper and whose nationality was a secret between Mike and his Maker.

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LIKE the goddesses of the old Greek mythology, Mike was obscured from mortal vision by a cloud of mist. According to the Greek legend if the mist were dispelled even for a moment, mortals would be stricken blind by the glory of the spectacle. A conference with Mike was astonishingly like an olden-time consultation of the Delphic Oracle. The suppliant, it will be recalled, approached a dark cave from which proceeded loud rumblings and sulphurous vapors, in whose midst the priest could be dimly seen seated upon a tripod (perhaps the precursor of the grasshopper crane). The anxious seeker shouted his question and would be answered at once with a torrent of half intelligible words in one of the lesser Balkan dialects, susceptible of at least three interpretations. He would then retire and spend the rest of the day trying to figure out what the answer meant.

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IF Mike could say "O. K. boss" he was considered fluent. If he could make a short straight line with a soft pencil and count up to five it was considered that he was crowding Professor Einstein and had the boss in the hollow of his hand. You took what you got from Mike and you liked it—or else. In sharp contrast we have **Mr. Lease,** a Johns Hopkins graduate if my memory serves me, entertaining us with three-dollar words, quoting doctors of philosophy, and, with a humility which was ever lacking in Mike, pleading for more research and a better understanding of the problems of pickling.

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THESE changed conditions were brought about by a number of factors of which no doubt the most potent is the growing use of those very inhibitors of which the author speaks. They and the foam blanket broke the monopoly of the Balkan states in the cleaning house. They were powerfully aided by permanent non-leaking tubs, measuring tanks, and self propelling cranes with cages for the riders. Pickling can now be seen and studied, and laboratory results can be tolerably well checked in practice.

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I thoroughly approve of **Mr. Lease's** appearance in the columns of Wire and Wire Products. It is high time we heard from the man on the crane. Moreover, ours is an industry without a technical literature. The various bits of knowledge that have a bearing on wire making are scattered throughout the records of technical societies and private files. So far as possible they should be reproduced in this magazine, even though they consist only of opinions and compilations of facts generally known and already of record. It is in that spirit that I add to **Mr. Lease's** observations some opinions and observations from the foreign press.

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THE effect of pickling on mild steel is well shown in figure 358, reproduced from **Maurice Bon-**

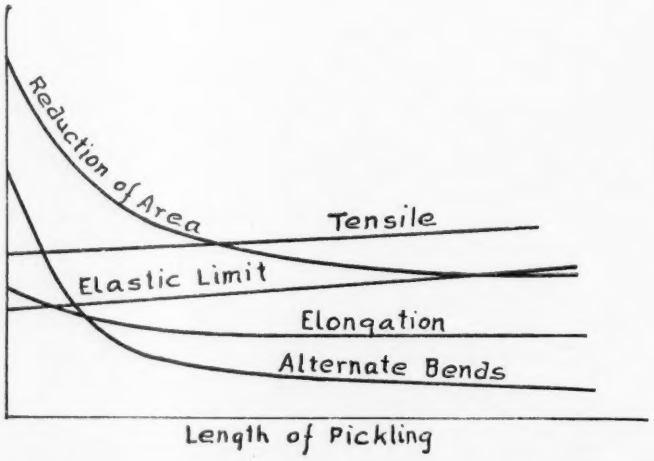

Fig. 358—Influence of pickling on physical properties of mild steel wire. Top to bottom—Tensile, Reduction of area, Elastic limit, Elongation, Alternate bends. ✦ ✦ ✦ ✦

zel's excellent book on steel wire of which I am publishing an English translation. It is seen that tensile strength and elastic limit increase with the length of immersion, which explains, although it does not justify, a practice said to be prevalent in Europe, of soaking springs in acid to give them more "life". At the same time there is a decided drop in reduction of area, elongation, and especially in alternate bends.

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BONZEL reports the following changes in properties in a .55 carbon wire, annealed, with a granular pearlite structure. See Table 1.

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HE states that the malleability is fully restored after a time interval which varies according to conditions. Simple exposure to the air will restore the properties in three months, the intermediate stages of recovery being shown in

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FOUR days in running water will completely restore the malleability. Immersion in boiling water is of course more effective, as shown by table III.

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VACUUM extraction will work quite as effectively, but will require 6 days.

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MR. LEASE has spoken of the relatively large volume of gas absorbed in the steel. According to **Bonzel** this volume is usually about equal to the volume of the steel. It can be readily imagined that the pressure is enormous. There are several ways to demonstrate this pressure. If a tube is tightly plugged at its lower end, the upper end equipped with a pressure gauge, and the tube immersed in acid, hydrogen passing into the confined space will register a pressure as high as 4000 pounds per square inch. If a tube whose exterior is enameled is subjected to acid attack on the inner walls the enamel will be forced off by the pressure of hydrogen diffusing through the wall.

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EXPERIMENTS of **Bardenheuer** and **Thanheiser,** as summarized in figures 366 and 367, show that in the commercial range the speed of attack increases with higher temperatures and concentrations, this being true of inhibited as well as of plain sulphuric acid. In these two figures the full

Table I

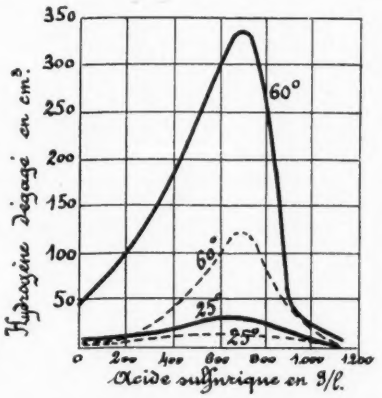
Annealed high Carbon steel .077"	Before Pickling	After Pickling in 10% 66° acid		
		15 min.	40 min.	18 hours
Tensile, psi	82,000	82,000	82,000	82,000
Elongation in 4"	24	22	20	18
Alternate bends (r=.2)	30	11	8	5

Table II

Time	0	2 hours	6 hours	11 days	1 month	3 months
Bends	5	6	18	23	27	32

Table III

Time	0	½ hour	6 hours	24 hours
Bends	5	19	26	34



lines show plain acid, the dotted lines inhibited. Acidity is reported in grams per liter, temperature in degrees centigrade and volume in cubic centimeters. Figure 366 shows hydrogen evolved, and 367 hydrogen absorbed by the steel.

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FIGURE 368, in which it is to be noted that the full lines show inhibited and the dotted lines straight acid, records the ratio between hydrogen absorbed and hydrogen evolved. Here the interesting point is that while with plain acid there is relatively more hydrogen absorbed at higher temperature, with inhibited acid the reverse is true—the higher temperature results in less absorption. In both cases the relative absorption is less as the acidity rises.

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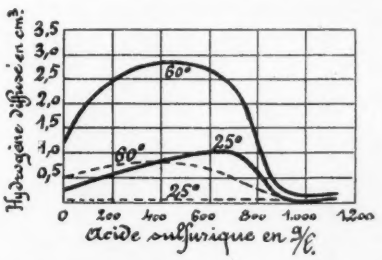
THE conclusion drawn by the authors is that so far as the time factor is concerned the best practice is to pickle in hot strong solutions well inhibited. Unfortunately this conclusion is valid only for the particular inhibitor tested. Furthermore the time factor is not

(*Please turn to page 243*)



Figs. 366 and 367—Influence of concentration and temperature on amount of hydrogen evolved (degage) and amount absorbed (diffuse). Solid line-straight acid. Dotted lines—with inhibitor.

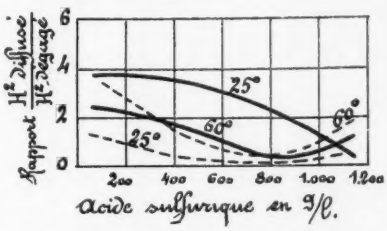


Fig. 368—Influence of concentration and temperature on the relation of $\frac{\text{Hydrogen absorbed.}}{\text{Hydrogen evolved.}}$ Solid lines—with .5% "fixo-decapeur." Dotted lines—without inhibitor.

Shielding By Wire Braid

By Jack Delmonte

Electrical Engineer, Naval Aircraft Factory, Philadelphia, Pa.

Adequate shielding of conductors of electrical energy aid in the elimination of radio disturbances. Formulae for calculating such shields are given here. ✦ ✦ ✦ ✦

THE recent agitation in this country and abroad for minimizing radio disturbances has awakened interest in the problems of shielding conductors of electrical energy, which behave as a source of disturbance. With the supersensitive receivers for short wave and distance reception now in vogue, the elimination of radio disturbances is becoming a greater problem, and the efforts to gain this end must be encouraged.

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CABLES that are carried in solid conduit, which are well bonded electrically at the fittings, find adequate shielding. On the other hand, cables that have no metal covering about the outside are disturbing influences, particularly if they carry high potentials that appear off and on the circuit frequently. These cables can be easily shielded as will be seen from the data following.

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THE shielding medium, to begin with, must be a good conductor of electrical energy, offering as low a resistance as possible. In addition, there must be a complete continuity of the conductors comprising the screen and no casual contact in passing through fittings. A very satisfactory shield may be obtained by weaving about the cable, wires in the form of a braid; two up and two down being favored for the weave. The wires that are used should combine good conductivity with a resistance to corrosion; and consequently, tinned copper wires, flat or round, aluminum, and stainless steel have been used.

Formula A

$$\frac{(2P - P^2).100}{A\ \ B} = \text{Percent Coverage}$$

where $P = \dfrac{}{C \cos \phi}$

and A —One half (½) of total wires in shielding braid

B — Diameter of an individual braiding wire

$$C = \text{Pitch} = \frac{A}{\text{Total Parallel Wires Per Inch}}$$

D — (Overall Diameter Over the Braid — 2 B).π

ϕ — pitch angle = arc tan C/D

THE wires are closely woven in groups or 'picks', consisting of several wires, but not too many, as the wires may bunch together, overlap, and offer a poor screening surface. There are a number of factors that decide the coverage a shielding braid is providing. The coverage is a physical measure of the amount of surface covered by a shielding braid, such as illustrated in figure 1. It may be calculated by formula A.

* * *

FOR good shielding it may be said that approximately 80% coverage as calculated in the above formula would be satisfactory. Basically, the nature of the electrical disturbance determines the degree of shielding that is necessary. However, manufacturers are able to find in the above formula a method of evaluating the efficacy of their wire braid in well defined physical dimensions. Generally speaking, it becomes increasingly difficult with the larger diameter cables to provide a high coverage with a wire shielding braid; the best coverage has been

obtained with the smaller size cable, due to the smaller number of wires that are handled by the braiding machines.

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TABLE I gives some data for cables of various sizes, designating the number of braiding wires that are necessary to attain a coverage of 80%, 85%, and 90%, for a given braiding wire diameter and a given pitch. The dimensions are given in inches.

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THE last line in table I illustrates how it is possible to increase the coverage by shortening the pitch or angle of advance of the braid wires. It is of interest to know at what pitch a given number of wires, of a given diameter, and on a specified cable will combine to provide 100% coverage. This may be calculated from the formula B.

Formula B

$$\frac{2AB}{C\cos\phi} - \frac{(AB)^2}{C^2\cos^2\phi} = \text{Percent Coverage}$$

$$\cos\phi = \frac{D}{\sqrt{C^2 + D^2}}$$

Table I

Outer Diameter of Cable	Braiding Wire Diameter	Pitch	Coverage	Number of Wires Required
.500″	.010″	1⅝″	80%	126
.500″	.010″	1⅝″	85%	140
.500″	.010″	1⅝″	90%	156
1.00″	.010″	2¾″	80%	226
1.00″	.010″	2¾″	85%	250
1.00″	.010″	2¾″	90%	280
1.50″	.010″	3¼″	80%	294
1.50″	.010″	3¼″	85%	326
2.00″	.010″	3¾″	80%	354
2.00″	.010″	3¾″	85%	393
2.50″	.010″	4½″	80%	430
2.50″	.010″	4.0″	85%	430

ON substituting for the value of cos ϕ, differentiating the coverage with respect to the pitch, C, and setting equal to zero for the condition of maximum coverage, the following value of C is obtained for 100% coverage:

$$C = A.\ B.\ D.\sqrt{\frac{1}{D^2 - A^2B^2}}$$

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IN the same manner the requisite number of wires for 100% coverage with a given pitch, braid wire diameter, and specified cable may be found as:

$$A = \frac{C\cos\phi}{B}$$

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IN all the calculations given above it is assumed that the wires are lying flat and parallel, which, strictly speaking, is not so. The interweaving of the wires forms crevices that the formula does not consider. Nevertheless, for all practical purposes the method outlined above allows a creditable design of the wire shielding braid.

Triple Unit Electric Immersion Type Wire Annealing Furnace

THE Seneca Wire and Manufacturing Company, Fostoria, Ohio, has installed a triple unit electric immersion type annealing furnace made by the Bellis Heat Treating Company of Branford, Conn. This is shown, together with a good deal of the electrical equipment in the illustration.

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600 to 900 lbs. of wire are handled at a time, depending on the size. The coils are set up on the yoke, the pin is put in place and an electric hoist, operating from a jib crane handles the charging or unloading of the furnace, as well as the subsequent pickling, rinsing and other handling.

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PLATFORM trucks are used for moving the heavy coils from place to place. The coils are brought in this way to the furnace for annealing and are later removed from the rinsing tanks to the various departments for further processing. The average trucking load is about 4,000 lbs. and 6,000 lbs. are frequently handled by them.

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FOR fine wire the power consumption with these furnaces is about 141 KWH per ton and for coarse wire about 117 KWH per ton.

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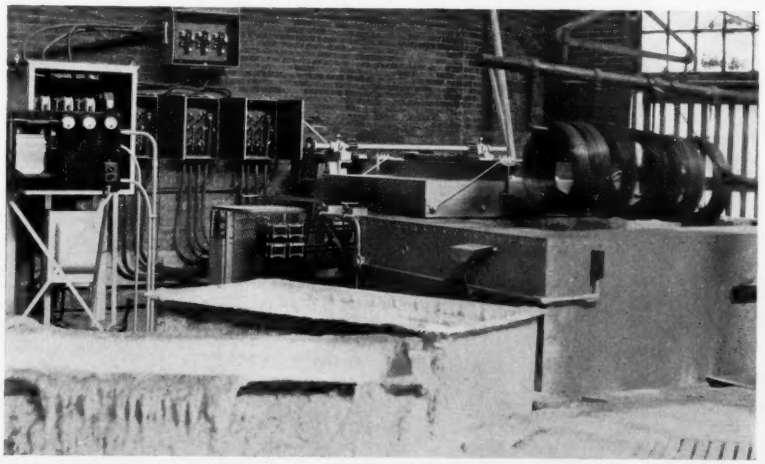

Triple Unit Electric Type Annealing Furnace.

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Exports and Imports of Wire

Exports of Iron and Steel Wire Products in March, 1935 and March, 1934
(In gross tons)

	March 1935	Feb. 1935	March 1934
Wire rods	1,354	1,681	1,180
Hoops, bands and strip steel	4,689	3,512	3,038
Plain black or galvanized iron or steel wire	3,470	1,892	2,842
Barbed wire and woven wire fencing	2,622	2,313	3,233
Woven wire screen cloth	97	74	62
Wire rope	525	319	220
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	590	306	328
Wire nails	1,270	548	1,300
Tacks	44	27	48
Other nails, including staples	226	231	427
Bolts, machine screws, nuts, rivets and washers	665	574	295
Total, these 11 classifications	15,552	11,477	12,973

Imports of Iron and Steel Wire Products Into The United States
(In gross tons)

Concrete reinforcement bars	92	.....	26
Hollow bars and drill steel	50	55	17
Merchant steel bars	1,442	1,604	1,031
Wire rods	1,881	952	1,300
Barbed wire	3,364	2,217	444
Round iron and steel wire	330	224	241
Telephone and telegraph wire	4	.....	1
Flat wire and strip steel	152	103	122
Wire rope and strand	204	113	130
Other wire	70	67	93
Hoops and bands	1,349	1,234	1,319
Nails, tacks and staples	1,339	966	540
Bolts, nuts and rivets	28	22	18
Total, these 13 classifications	10,305	7,557	5,282

Exports

SETTING what is at least a modern and very possibly an all-time record exports of iron and steel products in March reached the huge total of 323,035 gross tons—94,498 tons above the February figure of 228,537 tons and 61,766 tons higher than the March 1934, trade.

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THE marked gain in the export trade in March—94,498 tons—came as a result of increases in 41 of the 64 classes of iron and steel comprising this trade. The chief increase was in shipments of iron and steel scrap—76,610 tons—although the trade in car wheels and axles rose 7,595 tons, that in heavy rails 4,992 tons, that in ingots, blooms, etc., 2,663 tons, and that in galvanized wire 1,479 tons. Losses were registered in shipments of 23 classes of products—the largest being in cast iron pressure pipe and fittings, 1,340 tons, seamless casing and oil line pipe, 1,294 tons, tin plate, 1,149 tons, and steel bars, 1,016 tons.

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SCRAP iron and steel was, as usual, the principal product exported. Of its total of 228,338 tons Japan received 160,475 tons, Italy 27,783 tons and United Kingdom 20,224 tons. Other important products in this trade were, in order of tonnage, tin plate, car wheels and axles, ingots, blooms, etc., galvanized steel sheets, black steel sheets, and heavy rails.

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THE Far East continued as the principal market area for American iron and steel during March principally because of the shipments of scrap materials into that area. Some 60.5 percent of the March total was so shipped, the trade being rather above the average for the 1935 quarter year—55.4 percent. Europe, also because of scrap, was the second largest market with purchases making up by weight 20.6 percent of the March total or rather less than 23.8 percent average of the three-months period. Trade with the countries of North and Central America and the West Indies accounted for 13 percent of the trade of the subject month against 13.7 percent of that for the quarter, while South America took only 4.9 percent (against 6.0 percent), and Africa 1 percent (1.1 percent). With the single exception of South America each of these areas bought more American iron and steel in the 1935 quarter year than in that of 1934, and each market area without exception increased its purchases in March over February.

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THE largest individual market on a tonnage basis was, as usual, Japan whose purchase of 175,719 tons in all included 160,475 tons of iron and steel scrap, 7,772 tons of ingots, blooms, etc., 2,646 tons of tin plate scrap, and 1,153 tons of waste tin plate. Italy was the second largest market with total purchases amounting to 28,382 tons including 27,783 tons of scrap, while the United Kingdom included 20,224 tons of scrap in its total of 20,783 tons. Canadian purchases — 20,595 tons — were more diversified and included 4,316 tons of scrap, 3,059 tons of black steel sheets, 2,343 tons of steel bars, 2,030 tons of hot rolled hoops and strip, 1,575 tons of plain structural shapes, and 1,205 tons of cold rolled hoops and strip. Mexico's purchases were equally diversified and, totaling 11,771 tons, included 4,784 tons of scrap, and 1,027 tons of black steel sheets. China included 3,370 tons of heavy rails and 2,405 tons of scrap in its 8,893-ton trade; Soviet Russia bought 7,181 tons of car wheels and axles to boost her trade to 8,595 tons and thus became the month's seventh market on a tonnage basis; the Philippine Islands bought in all 6,442 tons of which 1,999 tons was galvanized steel sheets and 778 tons galvanized steel welded pipe; Poland took 5,047 tons of scrap; while Brazil, the tenth market, included 1,087 tons of tin plate and 610 tons of black steel sheets in its 2,685-ton total.

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Imports

FOURTEEN countries sent iron and steel to the United States in March, five being of relatively little importance as far as the quantity received from them is concerned, and nine of some consequence. Receipts from Belgium, Germany, and Sweden increased while imports from France, the Nether-

lands, Norway, Canada, and British India declined. It was the virtual withdrawal of the Netherlands from this market in March that accounted for the major part of the 7,496-ton drop in receipts from all countries.

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THE month's chief supplier on a tonnage basis was Germany which was especially active in the trade in barbed wire (2,852 tons) and in nails, tacks and staples (978 tons), the two largest items in her 5,530-ton trade. Belgium was second with a total of 4,586 tons included in which were 1,515 tons of structural shapes, 881 tons of hoops and bands other than cotton ties, and 662 tons of merchant and other steel bars. Canada was third, scrap (2,352 tons) and ferromanganese and spiegeleisen (1,205 tons) accounting for the major part of her total of 4,332 tons. Fourth was Sweden — her 2,225-ton total being made up chiefly of wire rods (1,041 tons) and merchant and other steel bars (380 tons).

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CARD CLOTHING imports nearly trebled—the entire 28,009 square feet valued at $32,130 coming from the United Kingdom.

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THE trade in **wire cloth and screening** gained slightly to total 70,182 square feet including 44,032 square feet which came from Germany, 9,456 square feet which entered from Canada, 8,126 square feet shown as coming from the Netherlands, West Indies, 4,309 square feet which was of French origin, and 4,259 square feet Swedish wire cloth.

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THE trade in **fourdrinier and other paper making wire** was slightly lower at 43,237 square feet—this total including 21,514 square feet of Austrian wire, 14,927 square feet of German wire, 3,781 square feet of Swedish wire, and 3,015 square feet of French wire.

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DECEIPTS of **wire heddles** were smaller by about 10 percent—the 1,494,000-piece total including 1,350,000 heddles from France, 123,000 from Belgium, and 21,000 from Germany.

WIRE fencing and netting imports increased sharply in March. Of that galvanized before weaving 1,608,107 square feet were received, 1,466,325 square feet from Germany, 84,750 square feet from the Netherlands, and 57,032 square feet from Belgium. Of that galvanized after weaving 732,448 square feet came in during March —the entire quantity being shown against Belgium.

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EXPORTS of iron and steel wood screws during March, 1935 totaled 48,307 gross, valued at $5,773. Of this total the Union of South Africa took 13,000 gross valued at $1,298; Japan 12,205 gross, valued at $1,360; Cuba 6,268 gross valued at $820; Colombia 4,185 gross valued at $618; Chile 3,560 gross valued at $381; Mexico 2,531 gross valued at $252; Salvador 2,255 gross valued at $200.

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EXPORTS of brass wood screws during the same period totalled 15,580 gross, valued at $1,892. Of this amount Mexico took 12,125 gross valued at $663; Chile 1,460 gross valued at $259; Canada 623 gross valued at $477; Costa Rica 247 gross valued at $112.

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IMPORTS of wood screws during the same period amounted to 35,850 gross, valued at $3,531, of which Sweden supplied 33,650 gross, valued at $3,395 and Japan 2,200 gross, valued at $136.

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Hotel Congress To Be Convention Headquarters

THE Wire Association has selected the Congress Hotel on Michigan Boulevard as the official convention headquarters for the meetings to be held September 30th to October 4th. 1935 inclusive. The Metal Exposition will be located at the International Amphitheatre but no transportation difficulties to those attending the meeting are expected.

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RAPID elevated service goes from the door of the Congress to the gateway of the Exposition Hall in about fifteen minutes. Bus service from the hotel is being arranged for direct to the Exposition grounds and in the event of driving or going by taxi, a direct boulevard route from the hotel avoids all traffic and delay.

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A SPECIAL reduction in rates to members of the Wire Association for the Convention period has been announced and it is requested that reservations be made on the post card which will be mailed members within the next thirty days.

Reels And Spools Standardization

Reprints of the report of this committee as published in the November, 1934, issue of WIRE & WIRE PRODUCTS, outlining the proposed new standards for reels and spools for insulated wire and cable can be obtained for 25c a copy.

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A Review of Recent Wire Patents

No. 1,996,061, MACHINE FOR FORMING WIRE FABRIC, Patented April 2, 1935 by Arthur Ernest Blashill, Sheffield, England.

This machine is adapted for forming wire fabric of the type having intermediate line wires which are connected to the stay wires at the point of intersection by separately attached wire locks formed around the two series of intersecting wires while the ends of the stay wires are wound around the outer line wires (margin wires).

✦ ✦ ✦

No. 1,996,652, ELECTRIC CONDUCTOR, Patented April 2, 1935 by William C. Robinson, Sewickley, Pa., assignor to National Electric Products Corporation, Pittsburgh, Pa., a corporation of Del.

It is stated that this conductor is particularly adapted for use where there are high temperatures and humid atmospheres, as in switchboard installations in boiler rooms, etc., the conductor including a primary insulating covering about the wire, this covering being unaffected by relatively high heat conditions during use, then one or more transversely crumpled paper strips presaturated with a moisture resistant bituminous product and laid about the insulating covering with the edges of the paper strips in overlapping relation.

✦ ✦ ✦

No. 1,997,237, SPRING STRUCTURE, Patented April 9, 1935 by Donald P. Schrier, Jackson, Mich., assignor to Reynolds Spring Company, Jackson, Mich., a corporation of Del.

This is described as an improvement on the border frame construction disclosed in U. S. patent 1,665,539 dated April 10, 1928, and particularly contemplates a border frame for spring structures having an overhang.

✦ ✦ ✦

No. 1,997,626, WIRE WRAPPING MACHINE, Patented April 16, 1935 by Constantine A. Caldes, Jersey City, N. J., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

A single machine is provided for wrapping insulating material simultaneously about two or more wires to be later assembled into a cable having two or more separately insulated conductors.

✦ ✦ ✦

No. 1,998,430, MACHINE FOR MAKING WIRE ROPE OR THE LIKE, Patented April 23, 1935 by John P. Barclay, East Haven, Conn.

More specifically, the invention covers a new forming head provided with pulleys arranged in sets, the pulleys of each set being arranged opposite the same point on the axis of the head. Means is provided to adjust each set of pulleys simultaneously.

✦ ✦ ✦

No. 1,998,582, MACHINE FOR TWISTING METAL WIRES, Patented April 23, 1935 by Karl Johan Jensen, Nydalen, V. Aker, near Oslo, Norway, assignor to Gunnar Larsen Whist, Oslo, Norway.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

It is claimed that even if the profile wires are of short length, this machine will twist them, the machine being adapted for continually twisting the wires about their axes in order to obtain a helically twisted single profile wire adapted for use in the manufacture of helical nails.

✦ ✦ ✦

No. 1,998,898, SPRING STRUCTURE, Patented April 23, 1935 by John A. Konkel, Detroit, Mich., assignor to L. A. Young Spring & Wire Corporation, Detroit, Mich.

More specifically, the invention lies in the provision of a clip means for securing braces and springs to spring structure frame parts, the clips being easily applied.

✦ ✦ ✦

No. 1,999,264, SCREW MACHINE, Patented April 30, 1935 by Fred N. Tilton, Hartford, Conn.

The machine structure includes a reciprocatory and rotary spindle with a device for engaging and rotating the head of a screw blank, freely turning rotary tools with cutting teeth and conforming rolling teeth which mill and substantially coincidently roll a thread on the blank.

✦ ✦ ✦

No. 1,999,273, CONDUCTOR, Patented April 30, 1935 by Arthur O. Austin, near Barberton, Ohio, assignor, by mesne assignments, to The Ohio Brass Company, Mansfield, Ohio, a corporation of New Jersey.

More specifically, the invention embodies an electrical power transmission line conductor so constructed as to reduce corona losses at high voltages and also so constructed as to damp out vibration.

✦ ✦ ✦

No. 1,999,502, CONDUCTOR FOR TRANSMISSION LINES. Patented April 30, 1935 by Henry M. Hall, Toronto, Ontario, Canada.

This conductor is stated to be so constructed as to reduce vibration, the stranded conductor having a cross section at any point shaped as a regular polygon and having its peripheral contour varied at different points in the length of the conductor.

✦ ✦ ✦

No. 1,999,942, MULTIPLE WIRE DRAWING MACHINE, Patented April 30, 1935 by Walther Nacken, Gruna, near Chemnitz, Germany.

So as to prevent the drawing solution from entering the gear in the machine frame, the container for the solution is arranged as a separate unit above the top wall of the frame so as to leave a space between the bottom wall of the container and the top wall of the frame.

✦ ✦ ✦

No. 1,980,890, READY-TO-SOLDER WIRE, Patented November 13, 1934 by George Tompkins, Wollaston, Mass., assignor of one-half to Burt M. McConnell. Specifically the invention relates to ready-to-solder wire. The title is advisably employed because the wire has physically associated therewith solder and a flux, so that when heat is applied to the wire through the medium of a soldering iron or the like, the solder will be melted and the wire will be soldered to a part to which it is to be connected.

✦ ✦ ✦

The underlying principle of this ready-to-solder wire is the employment of metals with melting points so widely separated that one of the elements of the wire may be melted by a soldering iron or similar means without melting the other element. More specifically where copper wire and solder are employed, together with a flux, the application of the soldering iron will cause the flux to function in connection therewith to act as a securing means for the copper wire. The device described includes a tubular wire of solder, flux enclosed in the tube of solder, and a conductor located in the flux.

By Arrangement With The Manufacturers' Committee of Reels And Spools Standardization

Reprints of the report of this committee as published in the November, 1934, issue of WIRE & WIRE PRODUCTS, outlining the proposed new standards for reels and spools for insulated wire and cable can be obtained for 25c a copy from

Wire & Wire Products
17 East 42nd St.
New York, N. Y.

Inhibitors

(*Continued from page 237*)

often of prime importance. Quick cleaning is not so important as uniform cleaning, at least in the wire mill, where pickling is done on a cycle. Moreover the question of finish enters the equation, and I know that with at least one inhibitor a better finish is secured without sacrifice by dropping the temperature and raising the acidity.

✦ ✦ ✦

IN the matter of theory of inhibitors **Girard**, in "La Revue de Chimie Industrielle," says "It must be admitted that no entirely satisfactory explanation has as yet been advanced. It may well be that inhibition is in effect a passivating of the metal surface resulting in a state of equilibrium between metal and acid; it may be that the nascent hydrogen is induced to form a protective sheath. It is entirely possible that chemical effect is aided by colloidal effects; some inhibitors are of a colloidal nature and may take up the role of "colloid protectors". (The inhibiting properties of colloids have been studied recently by Messrs. **W. Beck** and **F. Von Hessert** who reported in "Zeitschrift für Electrochemie", 37, 1931, p. 11, and who confirmed the tests reported by **Friend** in Chem. Soc. 119, 1921, p. 932). This view is supported by the fact that when they become flocculent they lose their power, and by the further fact that certain completely soluble products, alcohol, glycerine, sugar, etc., are very feeble inhibitors."

✦ ✦ ✦

INHIBITORS are chiefly organic substances. It seemed demonstrable at one time that the effectiveness of an inhibitor was a direct function of its content of nitrogen in the form of protein, and the assumption was quite natural that the phenomenon was one of passivation, linked to the effect of strong nitric acid on steel. This idea was exploded by the development of inhibitors absolutely free from nitrogen, and even of inhibitors essentially inorganic.

✦ ✦ ✦

IT seems safe to predict that the inhibitor will eventually yield up its secrets. Indeed if present trends continue toward their logical goal we may have inhibitors certified by the Bureau of Standards and rationed to us by the Inhibitor Division of the Bureau of Pickling, Federal Wire Administration. I hope I do not live to see the day, for it will mark the disappearance of another picturesque figure, that genial friend of all the world, the inhibitor salesman. Always good for a drink, often for a dinner, his cigars sweeten the pickle-house atmosphere quite as much as his foam blanket, and his sulphurous anecdotes probably contribute more than acid fumes to the corrosion of the trusses and so give the painters a break. I am for conserving a little of the romance of wire, and hope that inhibitors will remain a few years more occult from human understanding.

WIRE ASSOCIATION CONVENTION HEADQUARTERS
SEPTEMBER 30—OCTOBER 1-4 INCLUSIVE

THE CONGRESS HOTEL, CHICAGO, ILLS.

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'Round the World With the Wire Industry

Consequences of the Devaluation of the Belga

IT is now possible to see more clearly the consequences of the devaluation of the Belga. The dreaded price cutting has not developed. The Iweco members are adhering to the prices and the non-cartel members have no competitive power, except on wire rods, and even in this product there has been no competition worth mentioning. However, the devaluation will let the Belgians renew competition in such markets, where under heavy pressure, the Iweco had been retreating. An agreement of this kind has been already arranged with the German industry. The latter will continue to operate on the so-called "safe" markets and will continue to foster barter operations, whilst the Belgian industry will try to regain lost ground in India and the Far East (Japanese competition) and everywhere, where American wire has got the upper hand on Iweco wire. For these markets special prices will be quoted, without however leading to the danger of a keen price war.

✦ ✦ ✦

Russia Buying From Germany

RUSSIA has placed a huge order in Germany for 200 Million Marks, of which a fair part is for iron and steel products. Amongst this will be also considerable quantities of wire products, amongst which 600 tons of wire rope and 250 tons of high tensile strength manufacturing wire and —for the first time—50 tons of stainless steel wire. The total quantity will be some 1500 tons all high grade wire products.

✦ ✦ ✦

Germany Reduces Latin American Barbed Wire Prices

PRICES for Waukegan barbed wire of American pattern will be reduced for all Latin American markets by 2/6-4 per T. The demand for this product has considerably improved.

✦ ✦ ✦

Barter For Hoops and Wire

EXPORT of hoops and wire products to the United States by barter is showing a very great development. Hoops for cotton baling are now almost exclusively exported by barter against U. S. cotton and wire nails to California also against barter for fruits, etc. The following figures may be of interest:

Total quantity traded with the U. S. against barter in 1933—0 tons; in 1934, first half—280 tons, second half—740 tons; and first *quarter* 1935—640 tons, including wire rope for the U. S. North Western districts.

✦ ✦ ✦

BARTER business with other markets is also showing a very

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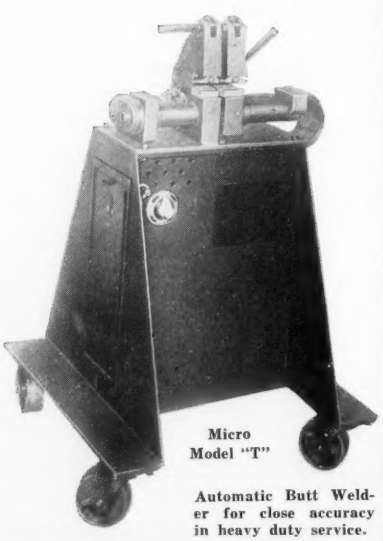


Micro Model "T"

Automatic Butt Welder for close accuracy in heavy duty service.

satisfactory improvement, and it is estimated that during the first quarter of this year more than 40% of the total wire exports were sold by barter.

✦ ✦ ✦

Latin American Market Continues Good

LATIN America is continuing to buy wire products, particularly Chile, Brazil and Colombia. But the European markets are very dull and certain price concessions have been made to the North European markets ranging from 2-5 per ton.

✦ ✦ ✦

Wire Rod Exports From Germany

WIRE rod exports to the U. S. from Germany include at present almost entirely 0. 1. wire rods of a tensile strength superior to ¼", chiefly ⅜" and 5/16" in heavy coils of 3-400 lbs. for which an extra price of $1.50 per ton is charged. The trade in ¼" and 3/16" wire rods has come nearly to a standstill.

✦ ✦ ✦

IWECO Under Canadian Wire Industry Not Yet An Agreement

REPORTS that the Iweco and the Canadian wire industry have come to an understanding as regards business in wire nails to Great Britain and West India are not confirmed. It had been reported that both parties were unanimous on a market distribution scheme and also on uniform prices, but these reports have been strictly denied by the Iweco.

✦ ✦ ✦

Germans Buy Wire Rods In United States

A GERMAN merchant has placed an order in the U. S. for 1200 tons of wire rods at 4/0 per ton below the price of the wire rod cartel. The wire rods will be shipped to the Balkan countries in 3-4 inch bundles.

✦ ✦ ✦

Prices For Wire Mesh Gauge

PRICES for wire mesh thinner than 30 G. wire have been increased on the world markets by 6-8%. More and more stainless steel wire mesh is in demand.

✦ ✦ ✦

Japanese Copper Output and Consumption

COPPER production in Japan is largely in the hands of two interests, Sumitomo and Furukawa. These two concerns control a very large percentage of production, and to all intents and purposes the entire sales, as they purchase the entire output of smaller mines.

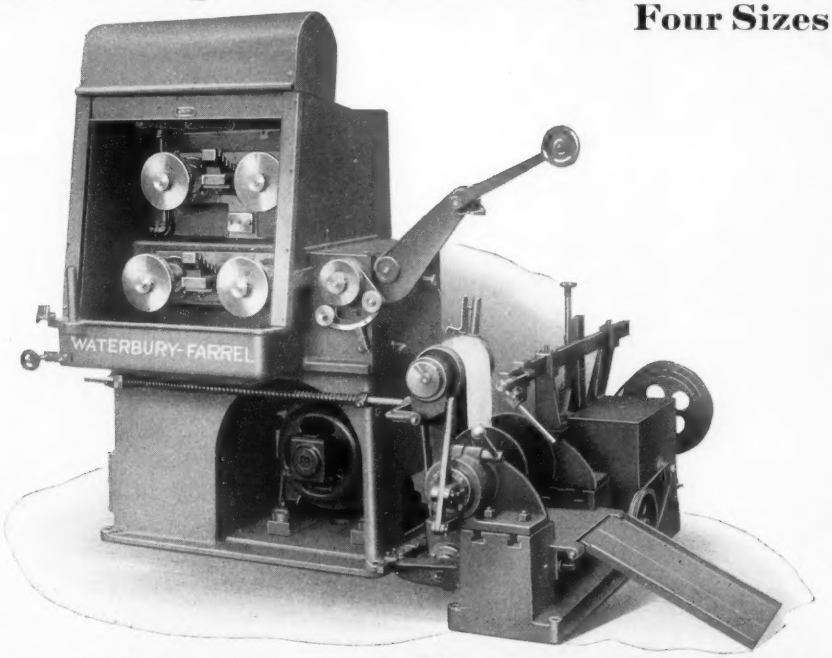
(*Please turn to page 246*)

Upright Cone Wire Drawing Machines---A Complete Line of Four Sizes

Max. Start No. 6
Min. Finish No. 44 B & S
Finishing Speeds
Up to 6,000 F. P. M.

Write for Cir. 891-W

Illustrating
No. 1 Machine - Start No. 14
B & S - 16 Dies, With
100 Lb. Spooler



Waterbury Farrel Foundry and Machine Company
Waterbury, Connecticut

Offices
Cleveland Philadelphia Chicago

'Round the World With the Wire Industry

(*Continued from page 245*)

IN 1934 copper production amounted to 66,400 tons, imports to 46,991, and consumption to 113,428; in 1933 production totaled 69,120 tons, imports 13,326, and consumption 82,514. The striking increase in demand in 1934 is accounted for chiefly by the extensive activities of the munitions industry. Producers, however, feel that the 1934 level in demand is abnormal and therefore are not willing to go to the expense of further exploitation of their properties.

✦ ✦ ✦

THE United States is practically the only suppplier of copper to Japan, having accounted for all but 85 tons of the 1934 imports. Indications are that the high level of consumption reached in 1934 will be maintained through 1935, which will result in continued heavy imports from the United States, as there is little likelihood of Japanese production of copper being "stepped up" to any appreciable extent. (Office of U. S. Commercial Attache, Tokyo).

✦ ✦ ✦

Columbus-McKinnon Chain Corp. Establishes South African Branch

THE Columbus-McKinnon Chain Corporation of Tonawanda, N. Y., has announced the establishment of a branch plant in Vereeniging, Transvaal, Union of South Africa.

✦ ✦ ✦

FOR many years the company has been supplying to the South Africa market and recently business has improved to the degree that the directors decided it would be more economical to build a plant in that country than to continue shipping its products from its Canadian plant.

✦ ✦ ✦

MEN from the Tonawanda plant and the Canadian plant are leaving for South Africa shortly to establish the new industry.

✦ ✦ ✦

Slight Rise in Canadian Wire Nail and Spike Production

VICE Consul James H. Wright, Cologne, reports the organization of a syndicate of German manufacturers of square wire netting in compliance with a governmental decree looking toward the restoration of sound domestic market conditions.

✦ ✦ ✦

Cia. Electro Siderurgica e Industrial De Valdivia To Make Additions To Plant

MACHINERY and accessory equipment for the installation of a steel and rolling mill, and to provide an additional blast furnace for the Cia. Electro Siderurgica e Industrial de Valdivia is to be imported, and will be exempted from all import duties and statistical charges. It is not known just what equipment the company will purchase, but a thorough study by the management is to be made shortly.

• YOU GET more than ten definite advantages and economies with the Ajax Hogue Wire Drawer attachment on your Cold Headers... Bulletin No. 110 gives you all the facts. SEND FOR IT!

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CLEVELAND, OHIO
Chicago Office: 621 Marquette Building

HOGUE WIRE DRAWERS

MANUFACTURED BY AJAX

SEND FOR BULLETIN 110 It's Yours for the Asking

New Czechoslovakian Iron and Steel Rolling Mill

A NEW iron and steel rolling mill at Luzec and Vltatvou, Czechoslovakia, is nearing completion and the plant is to be put into operation during November, 1934. It will have an estimated capacity of some 1,200 carloads annually, approximately 5 percent of the domestic cartel quota. It is not a member of the Czecholsovakia Iron and Steel Cartel and the question has arisen as to just how its products will be distributed.

✦ ✦ ✦

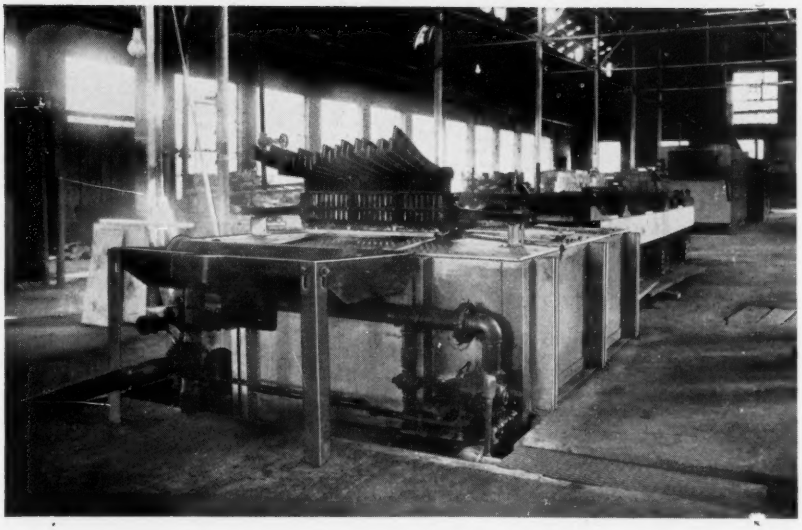
British Join Continental Steel Entente

THE British iron and steel industry, represented by its National Iron and Steel Federation, has reached a temporary agreement with the Continental Steel Entente effective for three months which provides (1) for the importation by the British of 167,750 tons of Entente steel products monthly, (2) that the British industry is to request its Government to remove the March 26 increase in duties (on that date the duties of many iron and steel products were increased from 33 1/3 percent to 50 percent), and (3) for the continuation of active negotiations for the establishment of a long term agreement between the two groups. The effective date of this temporary agreement is unavailable and is apparently not definitely decided.

✦ ✦ ✦

Japanese To Operate Plant in India

FOUNDATIONS for steel plant are reported completed by **Japanese** interests near Calcutta, **India.** The operating company, to be designated as the India Iron Manufacturing Company, with a capitalization of Y3,000,000, will produce chiefly round bars and angles and will have an annual capacity ranging between 50,000 and 60,000 tons. While the company will be under the nominal direction of an Indian, it is reported that actual management will be vested in Sadakichi Sakaguchi, chief director of the Osaka Iron Industry Guild, and Mr. Murotaro Senda.

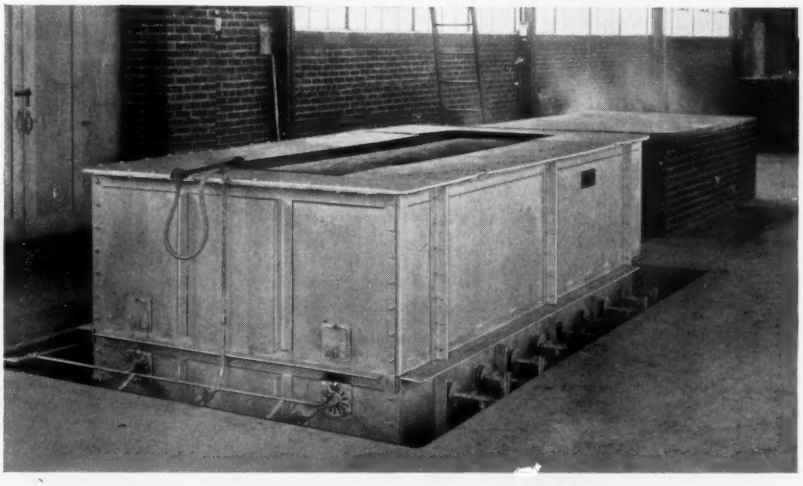


SC WIRE GALVANIZING FURNACES

The wire galvanizing furnaces illustrated here are only a few of the numerous SC installations producing economical, dependable uniformity of galvanizing. These correctly engineered furnaces have definitely established their value in many mills.

Whether for wire galvanizing, patenting, hardening, or annealing, SC furnaces permit increased production,—improved surface,—better physical properties,—dependable uniformity.

WRITE FOR INFORMATION ON SC FURNACES



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Also makers of.. ATMOSPHERE FURNACES... HARDENING, DRAWING, NORMALIZING ANNEALING FURNACES... FOR CONTINUOUS OR BATCH OPERATION

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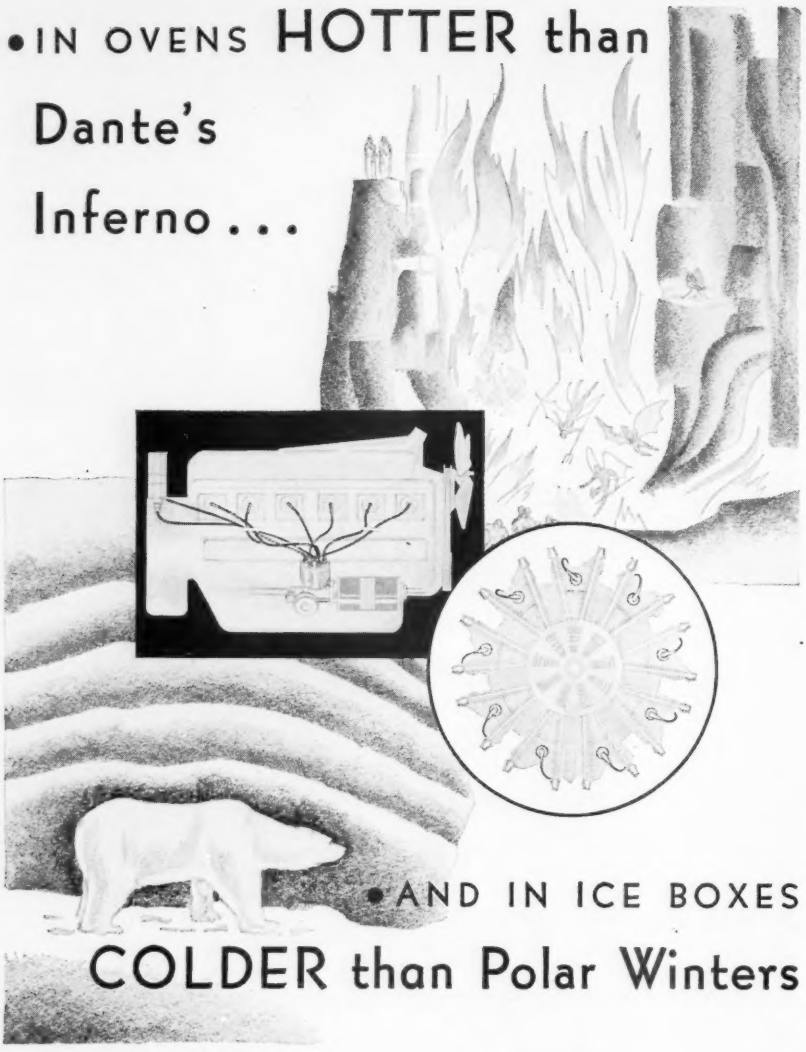

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There is no imaginable practical requirement that A & W's amazing cable lacquer has not greatly exceeded in these tests. No heat approaching that of the searing ovens. No cold like that of sub-zero ice boxes. Other extreme tests have amply demonstrated that the point of failure in this cable lacquer is far beyond even abuse.

As a result you can confidently expect in this lacquer the qualities that the industry has hitherto been vainly searching for. It is a product "tailor-made" for exacting conditions. It will prove its definite superiority as readily when applied in your lacquering towers as in ours.

You are invited to ask for a sample of cable coated with A & W's cable lacquer. Give it *your* mandrel, cold, oil, and heat tests. And you will be as enthusiastic about it as we are.

AULT & WIBORG CORPORATION
NEW YORK, N.Y. CINCINNATI, OHIO
HIC ET UBIQUE

Hard Drawn Copper Wire

(*Continued from page 235*)

ods of drawing did not effect the conductivity of the annealed wires.

✦ ✦ ✦

Conclusion

REVERSAL of the direction of drawing during the process of cold-drawing copper wire causes a slight decrease in the electrical conductivity, but does not appreciably alter the cell orientation.

✦ ✦ ✦

Summary

COLD-DRAWING of copper wire is shown to cause a definite type of preferred orientation of unit cells in the core. This orientation is such that the 111 and the 100 planes, which are the planes of easiest slip in face-centered cubic lattices, are in positions which militate against optimum ease of deformation. Deformation by shearing takes place easiest when the planes of easiest slip make an angle of 45° with the deforming force. The cell orientation at the core causes this angle to vary widely from the optimum. Micrographs and directional properties corroborate this conclusion.

✦ ✦ ✦

THIS cell orientation has an effect on the electrical conductivity also. Conductivity is a function of the "drifting" or free electrons by an impressed electromotive force. The core orientation places the most densely populated atomic planes directly across the path of drift, and too these planes have the greatest interplanar distance for this type of symmetry. A greater possibility for staggered planes is added to these two conditions and from the three is developed a theory for the increased electrical resistivity of the core of cold-drawn wire.

✦ ✦ ✦

SAMPLES of wire were drawn with various combinations of reversal of drawing direction. The electrical conductivity of wires drawn in the straight forward method was slightly higher than the conductivity of wires whose drawing directions had been reversed. The tensile strength was not noticeably affected by such reversal.

PERSONALITIES

A. W. Herron, Manager Wire Department, Jones & Laughlin Steel Corp.

A. W. HERRON has been appointed manager of the wire department of the Jones & Laughlin Steel Corp., Pittsburgh, Pa.

✦ ✦ ✦

MR. Herron was formerly junior Cincinnati sales manager for the corporation and has been succeeded in that work by Mr. M. M. Harper who has been named Cincinnati district sales manager.

✦ ✦ ✦

Homer C. Butts, Now Assistant to the President, Sharon Steel Hoop Company

HOMER C. BUTTS, former vice president of the Newton Steel Company has been appointed assistant to the president of the Sharon Steel Hoop Company. Mr. Butts has been with the Newton company since 1924, starting as a metallurgist. He advanced to assistant vice president in charge of operations and in 1931 was named vice president of the company.

✦ ✦ ✦

Editorial Correction

THE article entitled "Spot Welding" on Page 143 of the April 1935 issue, was incorrectly contributed to K. B. White.

✦ ✦ ✦

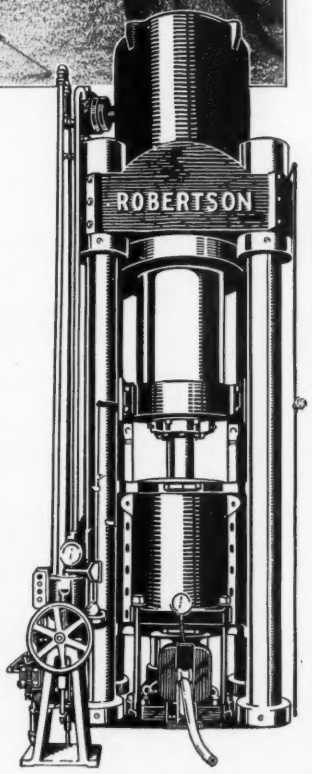
THIS article was written by Lawrence Ferguson of the Bell Telephone Laboratories, New York, N. Y.

✦ ✦ ✦

Canadian Output Up in 1934

STATISTICS recently released by the Dominion Bureau of Statistics report **Canada's** production of wire fencing in 1934 to have amounted to 8,602 net tons, sales to 9,475 net tons, and the income from these sales to $858,349. These figures compare with 6,758 tons, 7,328 tons, and $695,078, respectively, for 1933. Woven wire farm fence was easily the most important item in the 1934 production and trade, accounting for 7,360 tons of the total production 7,959 tons of the sales, and $642,445 of the income from sales.

Robertson
LEAD ENCASING PRESSES



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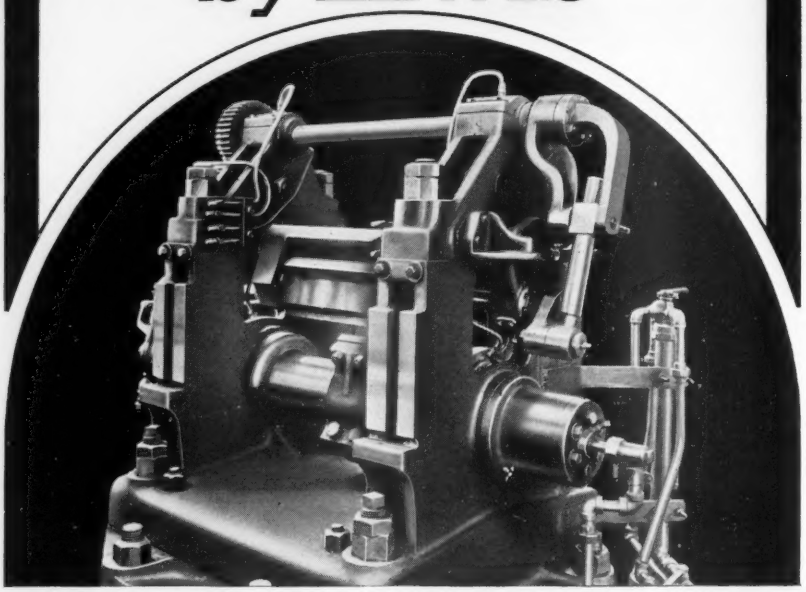

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PITTSBURGH, PA.

LEWIS FOUNDRY & MACHINE CO.

PERSONALITIES

Frank C. Davis, Superintendent of Republic Blast Furnaces at Youngstown

FRANK C. DAVIS, of Buffalo, has been appointed blast furnace superintendent at the Youngstown plant of the Republic Steel Corp., succeeding Francis M. Rich transferred to Buffalo.

✦ ✦ ✦

MR. Davis recently won the Johnson award for engineers under 35 for outstanding contributions to the industry.

✦ ✦ ✦

Universal Steel Co. Appoints Graff to Research Staff

HOWARD F. GRAFF has been appointed to the research staff of the Universal Steel Co., Bridgeville, Pa. Mr. Graff until recently was research assistant at the Cleveland Wire Works of the General Electric Company.

✦ ✦ ✦

Wheeling Steel Corp. Appoints Fox Superintendent New Hot Strip Mill

CLIFFORD R. FOX, for the past five years in charge of the blooming mill, bar and 60-inch hot strip mills at the Steubenville, O., plant of Wheeling Steel Corp., has been appointed superintendent of the new wide hot strip mill of Bethlehem Steel Corp., at Lackawanna (Buffalo), N. Y. He is now superintending construction of the new mill at Lackawanna.

✦ ✦ ✦

C. A. Bishop Purchasing Agent For Anchor Post Fence Co.

C. A. BISHOP has been placed in charge of all purchasing activities of the Anchor Post Fence Company, Baltimore, Md. Mr. Bishop who has been treasurer since 1929, succeeds the late Guy E. Tarbert, who died of pneumonia April 23rd.

✦ ✦ ✦

PRIOR to his transfer to Baltimore, Mr. Bishop was in charge of purchases at the Cleveland, Ohio, factory. He will be assisted in his new position by F. M. Gude who served in the same capacity with Mr. Tarbert.

PERSONALITIES

Frederick E. Fieger, Vice President Manufacturing Operations, Jones & Laughlin Steel Corp.

FREDERICK E. FIEGER has been elected vice president in charge of manufacturing operations for Jones & Laughlin. He likewise has been made a director and a member of the executive committee.

✦ ✦ ✦

HE has been general manager in charge of manufacturing operations since 1929, and dates his affiliation with the company from 1917. At the latter time he went with Jones & Laughlin as superintenednt of the wire department at the Aliquippa, Pa., works, and in 1918 was appointed superintendent of the steelworks.

✦ ✦ ✦

HE was made assistant superintendent at Aliquippa in 1920; general superintendent of the company in 1923, and assistant general manager of the corporation in January, 1928. In October, 1929, he was appointed general manager in charge of all manufacturing operations.

✦ ✦ ✦

New Officers of L. A. Young Spring & Wire Co.

CHARLES E. MILLER and Lloyd H. Diehl were elected directors of the L. A. Young Spring & Wire Company at the annual meeting in Detroit, May 1st. They succeed Henry Ruen and A. D. Coffin, both employees of the company.

✦ ✦ ✦

MR. MILLER is president and general manager of the Michigan Steel Tube Products Company, while Mr. Diehl is present and general manager of the Detroit Gasket Manufacturing Company and director of Crown Cork & Seal Company.

✦ ✦ ✦

C. M. YOUNG was elected treasurer, that office formerly being held by L. A. Young who was reelected president. Other officers were reelected.

MAKE YOUR PLANS NOW TO COME TO THE WIRE ASSOCIATION MEETING

— DESCO —

A PICKLING STABILIZER ▲ ▲ ▲
FOR CARBON STEELS ▲ ▲ ▲

▲ ▲ ▲

The strong passivating effect of this excellent inhibitor insures a bright finish and forms a sound basis for a bright drawing technique—

▲ ▲ ▲

DELANY CHEMICAL CO.

COTTMAN AND MILNOR STS.,
PHILADELPHIA, PA.

A SAFE WAY TO BUY Wire

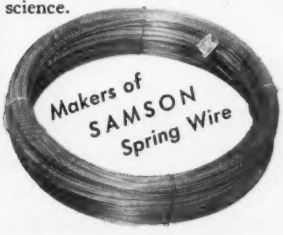
SPRING
BROOM
CLIP
FLORIST
GRAPE TIE
STAPLING
MATTRESS
WEAVING
TELEPHONE

Play safe! Let a Keystone technical man help you select wire with the exact characteristics suited to your needs.

Back of Keystone Wire is long specialized experience, painstaking laboratory and field tests, scientific control and careful inspection throughout all stages of manufacture.

Keystone Wire is made for many purposes—tinned, galvanized, coppered, liquor finish, annealed (low, medium, high carbon) and manufacturers' wire.

Each is a quality product of modern metallurgical art and science.



Keystone Steel & Wire Co., Peoria, Ill.

KEYSTONE WIRE

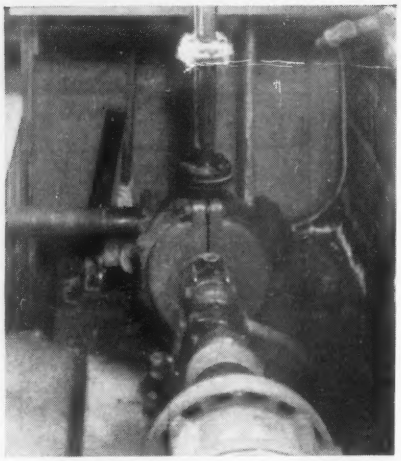
WASTE PICKLE LIQUOR

DURIRON Pumps, Pipe, Valves take it away

To neutralizing pools . . . to the river . . . to the acid recovery system . . . wherever you want it, you can use Duriron Equipment to advantage.

Practically immune to sulphuric acid, and very resistant to scale and other solids in suspension, Duriron Equipment gives Maintenance Men more time for other jobs . . . there are fewer replacements to make . . . the Pickling Department cost sheets reflect the good judgment of the Superintendent.

Why not find out if Duriron Equipment will serve your purpose economically?



DOWN IN THE PIT, Duriron pump used at Thomas Steel Co. for handling pickle liquor.

Drop us a line for bulletins on pumps, valves, pipe and fittings—no obligation, of course.

THE DURIRON COMPANY, Inc.

445 N. FINDLAY ST. **DAYTON, OHIO**

Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

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LAWRENCE, MASSACHUSETTS

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All cases submitted given personal attention by members of the firm. Information and booklet free.

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PATENT LAW OFFICES

Suite 438, Bowen Building 815-15th St., N.W. **Washington, D. C.**

Falls Steel Tube & Manufacturing Co. to Move to Warren

THE Falls Steel Tube & Manufacturing Company is planning to move its plant from Newton Falls, in Trumbull County, where it has been located for ten years, to Warren.

✦ ✦ ✦

Flexible Metal Bag Introduced by Reynolds Metal Company

THE **Reynolds Metal Company** recently announced the introduction of a new flexible metal bag by the Marks Coffee Company of Augusta, Ga.

✦ ✦ ✦

THE new bag is one of the first commercial coffee bags on which the metal appears on the outside, the coffee being contained in an inner glassine bag.

✦ ✦ ✦

PRINCIPAL features claimed for this new bag are its ability to prevent flavor loss over longer periods of time and due to its reseal protection value when folded, to maintain quality longer after opening.

✦ ✦ ✦

Newark Wire Cloth Booklet

WE are in receipt of a well illustrated 4-page folder published by the Newark Wire Cloth Co., 351-365 Verona Ave., Newark, N. J. The folder shows exterior and interior views of their plant (which is devoted exclusively to the making of Wire Cloth Products); illustrates and gives data on typical weaves and meshes; shows such leading products as Testing Sieves; Metallic Filter Cloth; Gasketed Metallic Filter Cloth; and a representative Riddle and Removable Bottom Strainer. It also contains a condensed price list.

✦ ✦ ✦

Jones & Laughlin Appoints James C. Foster General Manager of Sales

JAMES C. FOSTER, manager of wire sales for Jones & Laughlin, has been appointed general manager of sales.

LEWIS Foundry & Machine Co., a subsidiary of Blaw-Knox Co., has received an order for a complete, semi-continuous zinc strip rolling mill installation from the Ever Ready Co. of London, England, states Frank Cordes, president of the Lewis company. The company is building a duplicate of this installation for Ball Bros. Co. of Muncie, Ind., and these two mills, when completed, are expected to be the most modern and the largest zinc rolling mills in the world.

✦ ✦ ✦

THE order just received comprises roughing and finishing mills, tables, coilers, blocks, transfer tables, manipulating equipment, etc. In this installation the handling of the metal will be entirely automatic from the time it leaves the melting ladle until it reaches the warehouse in final finished form as rolled zinc strip.

✦ ✦ ✦

SHIPMENT of the English order will be made in approximately twelve weeks. Lewis Foundry & Machine Co. has specialized for many years in the design and manufacture of nonferrous equipment of this type. The company is now building various types of rolling mills for Canadian, Australian, Japanese and English buyers.

✦ ✦ ✦

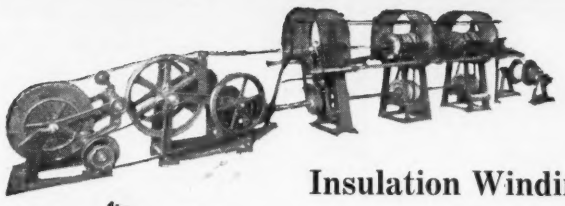
Rustless Iron Corp. to Manufacture Wire at Baltimore Plant

PLANS are in progress for construction of a wire manufacturing unit at the plant of the Rustless Iron Corporation in Edison Highway here. Plans provide for a one-story fireproof structure, 60 by 60 feet in size, to cost $50,000 or more with machinery and equipment installations.

✦ ✦ ✦

R. G. Harry New York District Manager Wrought Iron Company

THE Wrought Iron Company of Lebanon, Pa., manufacturers of genuine puddled iron, bolts, nuts, spikes and rivets, has announced the appointment of R. G. Harry as New York district sales manager and the removal of their New York City sales office to 90 West street.



HIGH SPEED BALL-BEARING

Insulation Winding Machine

for applying two tapes from concentric rolls and a cotton binder. Machine has automatic stops for broken tapes or exhausted rolls of tape. Can be built for any number of tapes.

EST. 1855 AIMCo INC. 1918
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
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NEW ENGLAND BUTT COMPANY
ESTABLISHED 1842
BUILDERS OF
Insulated Wire Machinery
Write for catalog
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CHICAGO OFFICE
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WIRE MILL FOR SALE
EQUIPPED TO DRAW FINE STEEL WIRE
In Sizes from No. 15 to 36. All Finishes.
Located in East—Accessible to all Markets—
Low price—Satisfactory Terms.
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Continuous Straightening and Cutting Machinery
With
FLYING SHEAR
for round and shaped wire.
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THE HALLDEN MACHINE COMPANY
THOMASTON CONNECTICUT

EFFICIENT PICKLING
Assured With
RODINE
Rodine saves acid and metal, prevents acid brittleness, and reduces acid fumes.
Samples and complete information sent on request.
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Detroit Office and Warehouse
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Subsidiary of
Thomson-Gibb Electric Welding Co.
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Broden Construction Co.
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CLEVELAND, OHIO

WIRE MILL EQUIPMENT
MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

RUESCH
Machinery For
Wire, Tube, And Brass Mills
409 Mulberry St., Newark, N. J.

WIRE DRAWING MACHINERY AND EQUIPMENT
Rod Frames—16″ Frames, 8″ Frames —Take-Up Frames, Wire Pointers—Puller Tongs.
General Castings for Wire Mill use. Circulars on Request.
E. J. SCUDDER FOUNDRY & MACHINE CO.
TRENTON, N. J.

HIGH SPEED
Welding Wire Straightening and Cutting Machinery
Round Wire Straightening and Cutting Machinery
Flat Wire Straightening and Cutting Machinery
Roll and Rotary Wire Straighteners
THE F. B. SHUSTER CO.
New Haven, Conn.
Straightener Specialists Since 1866

VIANNEY
1893—Awarded Gold Medal, the only prize for diamond dies in U. S. A., Chicago Fair.

WANTED: Good Used Machinery for winding 22 gauge wire with cotton yarn. In quoting state age, condition and where available for inspection. Address Box 101, c/o Wire and Wire Products, 17 East 42nd St., New York, N. Y.

Equipment Designs For The Pickle House

"EQUIPMENT Designs for the Pickle House" is the title of a new 26-page booklet issued by the International Nickel Company of New York.

✦ ✦ ✦

THIS booklet deals with pickling operations of all kinds, setting forth the latest information on pickling apparatus design and is illustrated liberally with photographs and drawings.

✦ ✦ ✦

THE booklet also treats of the continuous pickling of parts, pickle house accessories and the construction of pickling tanks. Copies may be obtained either from WIRE & WIRE PRODUCTS or from the International Nickel Co., 67 Wall Street, New York.

✦ ✦ ✦

THE "Romance of Diamonds" is the title of a new industrial booklet giving the history and development of the diamond and its use in commercial tools for various purposes.

✦ ✦ ✦

A COPY of this booklet may be obtained by writing direct to William Schwartz, Selma Mercantile Corp., 24 State Street, New York, N. Y.

✦ ✦ ✦

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SINCE 1870
Balloffet Diamond Wire Dies Co., Inc.
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PAPER INSULATION YARNS
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ZINC STRIP
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TUNGSTEN CARBIDE DIES
For Wire, Rod and Tubing
Round and Special Shapes
TUNGSTEN ELECTRIC CORP.
BISSETT STEEL DIVISION
Cleveland
Cincinnati Chicago Philadelphia

Wire Drawing Diamond Dies
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WIRE DIE CORPORATION
300 W. 56th ST., NEW YORK
Tel. Col. 5-1340

BUYERS' GUIDE

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ANNEALING FURNACES
See Furnaces—Various Headings

ANNEALING POTS AND BOXES
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Co., Cleveland, O.
Vaughn Machinery Co., Cuyahoga Falls, O.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Borden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CRANES—Wire Mill
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Union Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Cochaud Wire Die Corp., New York.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Union Wire Die Corp., New York, N. Y.
Vianney Wire Die Wks., N. Y.

DIES—Rod and Tube Drawing
Bissett Steel Co., Cleveland, O.
Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Union Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Kelly Wire Die Corp., New York, N. Y.
Vanadium-Alloys Steel Co., Chicago, Ill.

DIES—Tungsten Carbide
Carboloy Co., Inc., Newark, N. J.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Union Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

ENAMELS and LACQUERS—
Ault & Wiborg Corp., Cincinnati, O.

ENGINEER—Consulting Wire Mill
Lewis, Kenneth B., New York, N. Y.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

FURNACES—Wire, Strip and Sheet
Electric Furnace Co., Salem, O.
Surface Combustion Co., Toledo, O.

GEARS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis Foundry & Machine Co., Pittsburgh, Pa.

GRINDERS—Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Norton Co., Worcester, Mass.

HANDLING EQUIPMENT—Material
Cleveland Electric Tramrail, Div. of Cleveland Crane & Eng. Co., Wickliffe, O.

HOISTS—
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.

INHIBITORS
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

INSULATED CABLE LACQUERS and ENAMELS—
Ault & Wiborg Corp., Cincinnati, O.

INSULATION—Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LUBRICANTS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt. Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading With Wire Drawing Attachment
Ajax Manufacturing Co., Cleveland, O.

MACHINERY—Copper Wire Drawing and Rolling
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Measuring Wire & Cable
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

BUYERS' GUIDE, Continued

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Fidelity Machine Co., Philadelphia, Pa
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

MATERIAL HANDLING EQUIPMENT—
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Inc., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Encasing
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLING MILLS—See Machinery—Rolling Mill

ROLLS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Republic Steel Co., Youngstown, O.
Superior Sheet Steel Co., Canton, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

STRIP—Steel
Continental Steel Corp., Kokomo, Ind.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Enameled For Coils
Winsted, Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Continental Steel Co., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.

WIRE—Non Ferrous to Specification
Hudson Wire Co., Ossining, N. Y.
Winsted, Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Continental Steel Corp., Kokomo, Ind.
Keystone Steel and Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

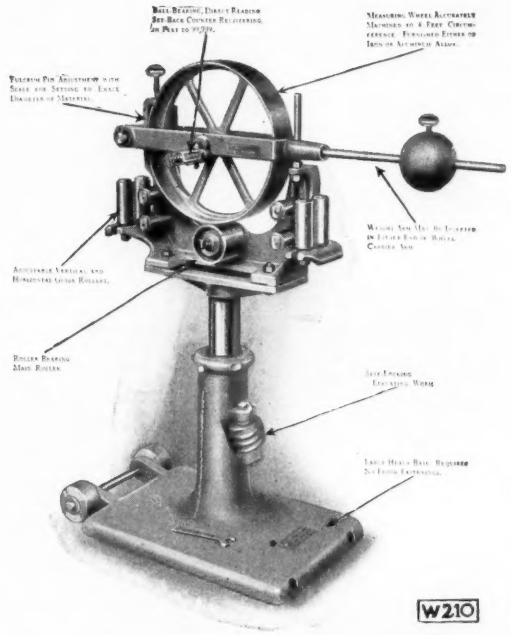
ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ENGINEERS - FOUNDERS - MACHINISTS

WIRE MEASURING MACHINES

Our Standard for years and still in demand



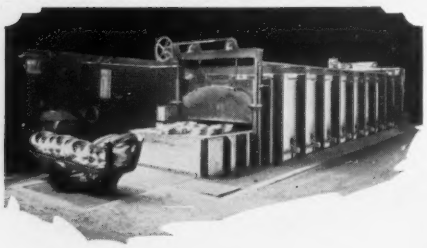
Made in two sizes: DC-2 for diameters up to 1″, and DC-3 for larger diameters up to 3″.

Three types of Measuring Wheels: Hardened Steel for galvanized and hard surface wires; Semi-steel for bare wire; and Aluminum for covered wire.
Machines furnished without Floor Stands for table mounting.

Smaller Measuring Machines, suitable for wires below ½″ diameter, also manufactured—ALL SIZES CARRIED IN STOCK.

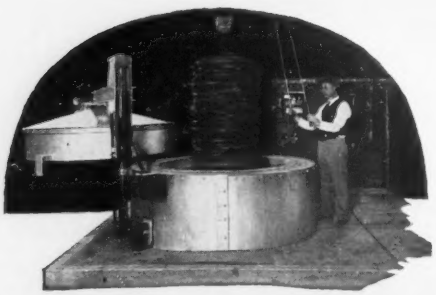
Send for bulletin for full details.

ELECTRICAL WIRE AND CABLE—WIRE ROPE AND CORDAGE MACHINERY



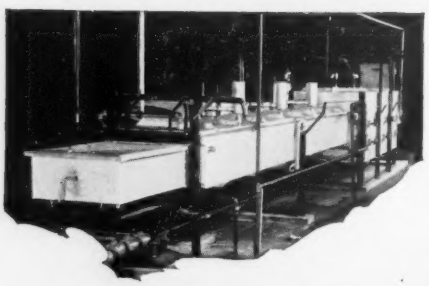
Clean Annealing Brass Wire

The continuous, gas-fired, controlled atmosphere furnace shown at left was built for a prominent brass and copper company for clean annealing brass and bronze wire in coils. The wire is carried through on a series of continuous alloy chains spaced to carry both small and large coils. The furnace handles 5000 lbs. per hour, and according to the purchaser "produces a high quality, low cost anneal with very good finish."



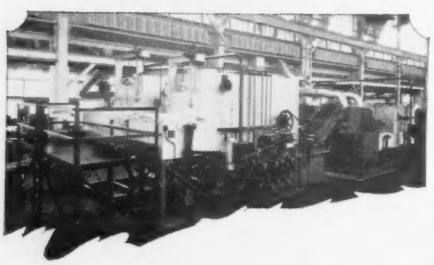
Annealing Wire Rod in Coils

The circular pit type, electrically heated furnace shown at left was installed in a prominent steel plant for annealing high carbon and alloy steel wire rod in coils without scale or decarburization. This is one of several similar furnaces we have built for this process.



Annealing Wire Bright and Dry

We have also built continuous controlled atmosphere furnaces with protective atmosphere for annealing wire in coils and on spools, and tubing in coils and straight lengths. The material comes out uniformly annealed, bright and dry, ready for shipment or further processing. A continuous furnace for bright annealing wire is shown at left.



Heat Treating Springs—Automatically

We have built several completely automatic installations similar to that shown at left for heat treating springs and miscellaneous products—uniformly and economically. The unit at left consists of a hardening furnace, quench, washing machine and drawing furnace, arranged in line and completely automatic. This type furnace also built for controlled atmopshere for scale-free hardening.

Annealing Low Carbon Wire

The view at left shows an installation of our improved fuel-fired equipment for annealing low carbon steel wire in coils. The several installations already made have shown decided advantages, including more uniformly annealed wire, increased tonnage per pit, greatly improved fuel economy, decreased annealing time and better surface condition. This equipment will produce bright or semi-bright surface or otherwise as desired.

We specialize on building equipment to fit the customer's particular requirements. Our engineers will be glad to consult with you on your problems.

THE ELECTRIC FURNACE CO.
SALEM, OHIO.

Fuel Fired Furnaces

Electric Furnaces